



Ballantine Laboratories, Inc.

PRELIMINARY MANUAL

MODEL 6125B/C

TIME AND AMPLITUDE TEST SET

GENERAL ELECTRIC
INSTRUMENTATION & COMMUNICATION
1200 KONA DRIVE
COMPTON, CA 90220
(213) 642-5317

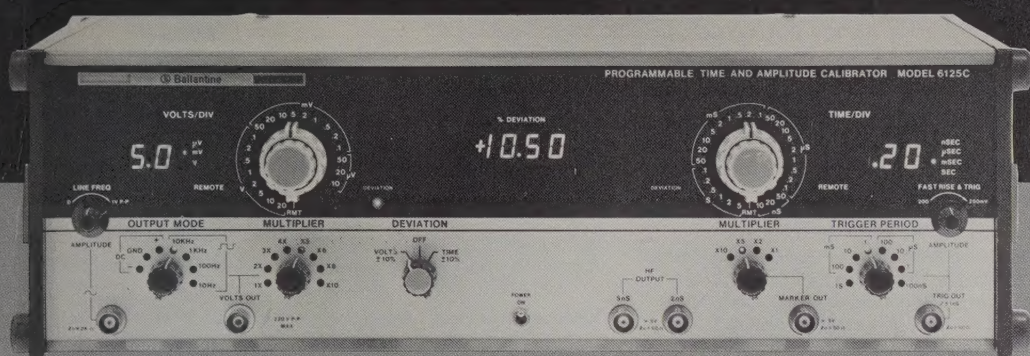
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MA31974

GENERAL ELECTRIC
REGISTRATION & LICENSING
1300 KONA DRIVE
COMPTON, CA 90220
(313) 645-6317

6125C



6125C PROGRAMMABLE TIME AND AMPLITUDE TEST SET

- ☐ **ATE COMPATIBLE.** Complete programmability or manual operation of all front panel functions. Adaptable to IEEE 488 interface bus.
- ☐ **FLEXIBLE.** Checks oscilloscopes, counters, multimeters, panel meters, signal generators, spectrum analyzers.
- ☐ **EASY TO USE.** Fast direct digital readout of error in percent.
- ☐ **WIDE RANGE OF SIGNALS.** AC and DC Volts: 10 μ V to 220 V.
Time (Frequency): <2nSec(500MHz) to 50 sec (0.02Hz).
Rise Time: <1nSec.
- ☐ **PORTABLE —** Small and light for on-site checkouts.

In one lightweight, easy to use test set, the Ballantine 6125C provides four precision instruments — a voltage calibrator; a sweep/delay-time or frequency calibrator; a risetime calibrator; and a % deviation error indicator. It is operable manually — and has an added powerful feature which provides the capability for complete programmability of all front panel functions. The unit can calibrate oscilloscopes at high speeds and the time saved in its use makes for major savings in test costs. The multiplicity of signal outputs available extends its usefulness to calibration and checks on other instruments such as frequency counters, signal generators, spectrum analyzers, panel meters and multimeters.

All programming for the Model 6125C is accomplished with digital logic. A choice of two modes of operation are available when remotely programming the instrument. In one mode the program maintains autonomous command of the test procedure. In the second mode the operator can override the program by manually setting the front panel controls for the desired output. When the front panel controls are returned to "REMOTE", the program resumes command. A front panel indicator lamp shows whether the Time or Amplitude section is under remote control.

When the 6125C is being programmed remotely, several LED lamps and digital displays on the panel signal whether the unit is under remote control, which range has been selected, what the output mode is, what trigger period is

in use, which multiplier step is on, whether it is in a voltage or time deviation mode, and what the percentage deviation is. These displays provide the operator with the kind of information needed to set the oscilloscope or instrument under test to appropriate ranges to match the programmed signals.

In summary, functions which are programmable in the Amplitude section of the instrument are the output modes, the voltage range, the voltage range multiplier for setting the number of divisions of vertical amplitude to be displayed, selection of the voltage deviation mode, and vernier control of the deviation. In the Time section the program can select the timing marker range, the number of markers displayed, vernier control of markers and time deviation. In the Risetime section any trigger period of the fast risetime squarewave can be selected. The readout of percentage deviation is also presented at a rear panel digital I-O connector. For fully automatic test equipment applications, an IEEE 488 Interface Bus adapter is available.

The 6125C programmable time and amplitude test set is a flexible instrument that can perform precision calibration checks in either the manual mode where its human engineered front panel, large knobs, and easy to read displays reduce operator fatigue to a minimum, or, it can be programmed to make tests at unprecedented speed when used in its remote programming mode. In either mode the substantial savings in test time it provides means greatly lowered costs compared to conventional manual methods.



Ballantine Laboratories, Inc.

FOUR DECADES OF INNOVATION IN ELECTRONIC INSTRUMENTATION

SPECIFICATIONS

VOLTAGE SOURCE

Ranges:

- (a) Volts/Division: 10 μ V to 20 V.
20 ranges in 1, 2, 5 sequence.
- (b) Number of divisions multiplier: X1, 2, 3, 4, 5, 6, 8, 10.
- (c) Absolute Range: 30 μ V to 220 Volts.

Output Modes:

AC positive-going square wave. 10 kHz, 1 kHz, 100 Hz, 10 Hz in four ranges. Frequency crystal controlled to $\pm 0.01\%$ accuracy.
DC positive.
DC negative.
GND

Accuracy: Better than $\pm 0.25\%$ into open circuit.

Offset: Less than $\pm 5 \mu$ V below 50 mV. (After use on ranges above 50 mV, a five minute settling time is required to minimize thermal effects.) Less than $\pm 50 \mu$ V above 50 mV. Note: The same offset is obtained on all output modes including GND.

Ripple and Hum: Less than 0.1% + 2 μ V p-p.

Square wave risetime: Less than 15 μ s.

Square wave overshoot: Less than 0.5%.

Regulation (for 1 M Ω Load): Not greater than 0.27% depending on V/DIV range setting.

Deviation Range: $\geq \pm 10\%$ with 0.01% resolution.

Deviation Accuracy: $\pm (1\% \text{ of full scale} + 2.5\% \text{ of reading})$.

Short Circuit Protection: Output is protected for short circuits of limited duration.

Reference: High quality zener diode.
Temperature coefficient $\pm 0.005\%$ per $^{\circ}$ C.

Temperature Coefficient of Voltage Output (15–35 $^{\circ}$ C):
Better than $\pm 0.015\%$ per $^{\circ}$ C ($\pm 150 \text{ ppm}/^{\circ}$ C).

Line Regulation for +10% line voltage change: $\pm 0.02\%$ max.

Stability: $\pm 0.12\%$ per year (maximum).

TIME SOURCE

Ranges: 2 nsec to 5 second intervals.

- (a) Markers: 10 nsec to 5 sec/div – 24 ranges in 1, 2, 5 sequence.
X1, X2, X5, X10 extends multiplier marker interval to 50 sec.

- (b) Sine Wave: 2 ns (500 MHz) – no deviation.
5 ns (200 MHz) – no deviation.

Sine wave output extendable to 1 GHz with 61251A Frequency Doubler.

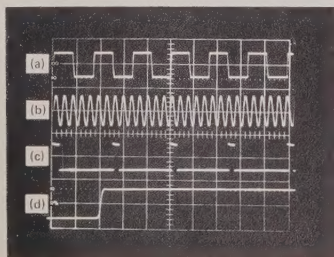
Marker Amplitude:

- (a) 100 nsec/div to 50 sec/div:
 $> 0.5 \text{ V}$ peak to peak into 50 Ω . 1.0 V peak to peak (typical) into 50 Ω . (1.4 V peak to peak minimum into open circuit.)
- (b) 10, 20 and 50 nsec/div: $> 0.5 \text{ V}$ peak to peak into 50 Ω .
- (c) 2 and 5 nsec/div: $> 0.5 \text{ V}$ peak to peak into 50 Ω .

Marker Shape and Width:

- (a) 100 nsec/div to 5 sec/div: Pulse; digitally controlled at mid amplitude to 10% of Time/Div marker interval.
- (b) 10, 20 and 50 nsec/div: Quasi-sinusoidal Pulse; width varies from 40% to 20% of Time/Div marker interval.

2 and 5 ns Output Shape: Sine wave.



Composite Oscilloscope of 6125C Outputs

- (a) Voltage Calibrator square wave
- (b) Time Calibrator (sine wave)
- (c) Time Calibrator (markers)
- (d) Risettime Calibrator squarewave

Accuracy:

Crystal controlled markers and sine outputs accurate to within $\pm 0.01\%$ of setting.
Crystal (clock) stability: 10 MHz, oven stabilized. Aging rate 3 parts in 10^{-7} per day after 72 hr. warmup. (See Option 14 for 3 parts in 10^{-9} per day aging rate.)
Note: Clock 10 MHz output ($> 250 \text{ mV rms}$) available at rear panel BNC. Also accepts any external clock or signal from 100 kHz to 10 MHz (at 1 V rms into 50 Ω).

Deviation Range (for 10 nsec/div to 5 sec/div markers):
 $\geq \pm 10\%$ with 0.01% resolution.

Deviation Range Accuracy: $\pm 0.2\%$ of full scale.

RISE TIME & TRIGGER OUTPUT

Amplitude: 200 mV to 250 mV continuously variable into 50 Ω (400 mV to 500 mV open circuit).

Risetime: Less than 1 nsec, positive going into 50 Ω .

Period: 0.1, μ sec to 10 seconds (10 MHz to 0.1 Hz in 9 decade steps.)

Waveform: Square Wave. Positive peak at ground reference.

Overshoot: Less than 2%.

Accuracy: Same as Time Source.

LINE FREQUENCY SYNC OUTPUT

Amplitude: Continuously variable from 0 to 1 volt peak-to-peak from max. 2 k Ω source.

Waveform: Follows powerline sine wave. Filtered to remove noise.

REMOTE PROGRAMMING

Programming of the Time and Amplitude sections is accomplished with binary coded TTL logic, positive true. Amplitude Section programmable functions: Volts/Div, Multiplier, Output Mode, Deviation. Time Section programmable functions: Time/Div, Multiplier, Trigger Period. HF Output on continuously except when time deviation mode operated. Program inputs for each section through rear panel 24-Pin Amphenol Blue Ribbon Type D connectors. Percent deviation meter readout isolated parallel BCD data, TTL compatible, positive true, on 36-pin rear panel Amphenol Type D Blue Ribbon connector.

GENERAL INFORMATION

Deviation Meter: 3-1/2 digit display with automatic polarity reads out time or voltage deviation to $\pm 10.00\%$. High brightness, four digit, 0.4 inch LED display.

Power Requirements: 100, 120 or 220, 240 rms volts, $\pm 10\%$, 30W, 50 to 400 Hz.

Operating Temperature: 0° C to $+50^{\circ}$ C ambient.

Storage Temperature: -50° C to $+85^{\circ}$ C ambient.

Humidity: to 80% RH for full accuracy; to 95% RH operating.

Dimensions: 16–38" wide, 5–1 1/4" high x 12" deep overall. (415.6 mm x 133.5 mm x 304.8 mm).

Weight: 16 lbs. (7.0 kg).
31 lbs. (14.2 kg) shipping weight.

Note: All accuracies specified at 23° C $\pm 1^{\circ}$ C with full compensation for output loading and referenced to a standard traceable to NBS with uncertainty of $\pm 0.01\%$.

PRICE: 6125C Time and Amplitude Test Set \$3950

OPTION 10

IEEE 488 Bus Interface Adapter. Allows 6125C to be programmed and controlled, and to output data via the IEEE Standard 488-1975 bus. \$1000

OPTION 14

High Stability Time Base. Proportional oven; < 3 parts in 10^{-9} per day aging rate after 7 days. \$235

AVAILABLE ACCESSORIES

61251A Frequency Doubler (to 1 GHz)	\$125
12630A Feedthrough Termination (50 Ω)	\$ 18



Ballantine Laboratories, Inc.

P.O. Box 97, Boonton, New Jersey 07005, U.S.A.

Telephone: 201-335-0900 TWX: 710-987-8380

All U.S.A. sales prices shown are net fob Boonton, New Jersey
Specifications and prices subject to change without notice.

General Information

1-1. INTRODUCTION

The Ballantine Model 6125 Time and Amplitude Calibrator is really a number of instruments in one case, to provide the facilities normally required for calibrating modern precision oscilloscopes, digital frequency counters, spectrum analyzers and simple voltmeters. It is simple to use. The operator sets the amplitude or time control to the value required, selects the appropriate function and multiplier settings and observes the waveform on the oscilloscope. If the trace does not coincide with the appropriate graticule marking, the deviation control is adjusted until it does. The error may then be read directly from the deviation meter as a percentage. In addition to the facilities for amplitude calibration and for checking synchronization/triggering at line frequency and at eight decade frequencies. The 6125C is fully programmable and provides an optional IEEE-488-1975 Bus capability. The instruments are portable and may readily be taken to the field or factory for "on site" calibrations.

1-2. VOLTAGE AMPLITUDE CALIBRATOR

An accurate DC voltage, either positive or negative or zero, or a selectable 10 kHz, 1 kHz, 100 Hz, 10 Hz positive going square wave is provided for amplitude calibration.

The VOLTS/DIV voltage control switch is designed to correspond with that on the oscilloscope. It is calibrated in 1, 2, 5 steps over the range 10 microvolts per division to 20 volts per division and in use is set to the

same setting as on the oscilloscope. A multiplier switch gives X 1, 2, 3, 4, 5, 6, 8 or 10 multiplication of the output so that the display may be expanded to suit the CRT graticule markings and to give a suitable display size. The multiplier may also be used to check linearity of digital multimeter.

The deviation control enables the output to be adjusted until the trace coincides exactly with the graticule divisions of an oscilloscope or the cardinal points of a voltmeter under test. The deviation meter on the 6125 will then indicate the percentage error.

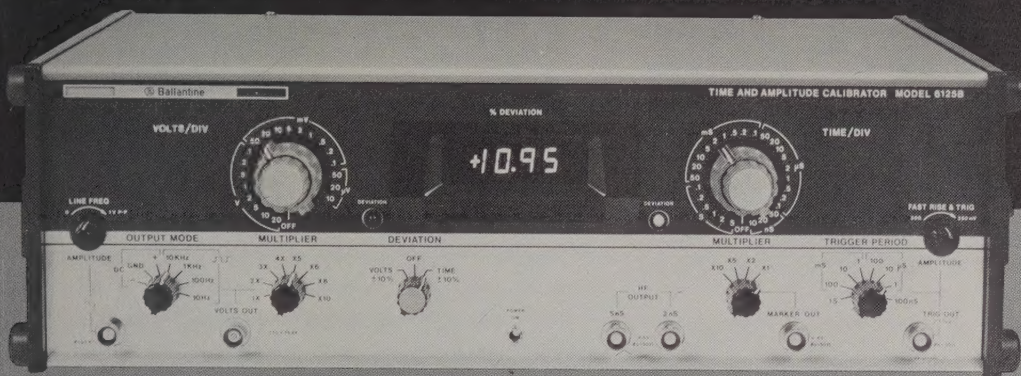
The square wave frequency is crystal controlled. The voltage reference is a high quality zener diode. The amplitude accuracy is 0.25%. The waveform has fast risetimes and flat tops to permit its use in the alignment of scope input attenuators.

1-3. TIME CALIBRATION

A high quality time-mark generator provides pulses for time calibration. This section is split into two ranges, each with an output connector. The main range covers from 10 nanoseconds per division to 5 seconds per division in 1, 2, 5 steps. The TIME/DIV switch setting correspond to those on the oscilloscope and as with the VOLTS/DIV switch, is set to the same setting as that on the oscilloscope. A multiplier switch gives X 1, 2, 5 or 10 multiplication of the output so that the display may be expanded to suit the CRT graticule markings and to extend the TIME/DIV calibrated range to 50 seconds per division.

As with voltage calibration the deviation control varies the spacing until the waveform coincides exactly with the scale divisions. The percentage error can then be read directly from the deviation meter on the 6125B.

6125B



6125B TIME AND AMPLITUDE TEST SET

- **FLEXIBLE.** Checks oscilloscopes, counters, multimeters, panel meters, signal generators, spectrum analyzers.
- **EASY TO USE. FAST.** Direct digital readout of error in percent.
- **WIDE RANGE OF SIGNALS.**
AC and DC Volts: $10\mu\text{V}$ to 220V.
Time (Frequency): <2nSec (500MHz) to 50 sec (0.02Hz).
Rise Time: <1nSec.
- **PORTABLE** — Small and light for on-site checkouts.

In one lightweight easy to use test set, the Ballantine 6125B provides four precision instruments — a voltage calibrator; sweep/delay-time or frequency calibrator; risetime calibrator; and an error indicator. Less in cost than the instruments it replaces, its functionally efficient operation cuts lab test time significantly. Used for its basic function of calibrating oscilloscopes, a minimum of $1\frac{1}{2}$ hours of lab test time can be saved per scope — $2\frac{1}{2}$ hours if the easily portable 6125B is brought to the oscilloscope. At \$15 per hour for test time, the 6125B pays for itself after as few as 50 instruments are calibrated.

The Voltage source provides an accurate dc voltage, positive, negative, or zero, and positive-going square waves from 10Hz to 10 kHz in decade steps. The Time source outputs are sharply defined precision timing pulses as well as sine wave outputs. The 6125B is ideally suited for calibration of oscilloscopes rated to 500MHz or very slow speeds.

Both the Voltage and Time source control switches have ranges corresponding to those on conventional oscilloscopes. Both of these sections include "Deviation" controls which allow the amplitude levels and timing pulses to be set exactly on the appropriate oscilloscope graticule lines. Percentage error is then read directly off a $3\frac{1}{2}$ digit display.

The Risetime and Trigger Output section provides square

waves with a risetime of less than 1 nanosecond at repetition rates with periods from 0.1 microsecond to 10 seconds to allow checks of amplifier risetimes and bandwidths.

The Line Frequency Sync Output provides a sinewave output of variable amplitude at line frequency, for convenient tests of trigger and sync circuits.

The frequency of all ac signals and markers are crystal controlled by reference to an internal 10MHz oven stabilized clock with an aging rate of 3 parts in 10^{-7} per day. If a higher stability signal is available, or if it is desired to use the 6125B as a precision frequency divider, any external clock signal from 100kHz to 10MHz can be fed to a rear panel input.

The 6125B Time and Amplitude Test Set gives the operator a simple, fast system to accomplish the most accurate calibration of oscilloscope parameters possible. Large control knobs, a bright digital display, and logical panel layout make it easy to use without fatigue or strain when many instruments are tested each day. And its multiplicity of signal outputs extends its usefulness to other instrument calibrations such as frequency counters, signal generators, spectrum analyzers, panel meters, and multimeters. The 6125B conserves time, bench space, cost, and tedium in the laboratory or on-site.



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SPECIFICATIONS

VOLTAGE SOURCE

Ranges:

- (a) Volts/Division: 10 μ V to 20 V.
20 ranges in 1, 2, 5 sequence.
- (b) Number of divisions multiplier: X1, 2, 3, 4, 5, 6, 8, 10.
- (c) Absolute Range: 30 μ V to 220 Volts.

Output Modes:

AC positive-going square wave. 10 kHz, 1 kHz, 100 Hz, 10 Hz in four ranges. Frequency crystal controlled to $\pm 0.01\%$ accuracy.
DC positive.
DC negative.
GND

Accuracy: Better than $\pm 0.25\%$ into open circuit.

Offset: Less than $\pm 5 \mu$ V below 50 mV. (After use on ranges above 50 mV, a five minute settling time is required to minimize thermal effects.) Less than $\pm 50 \mu$ V above 50 mV. Note: The same offset is obtained on all output modes including GND.

Ripple and Hum: Less than 0.1% + 2 μ V p-p.

Square wave risetime: Less than 15 μ s.

Square wave overshoot: Less than 0.5%.

Regulation (for 1 M Ω Load): Not greater than 0.27% depending on V/DIV range setting.

Deviation Range: $\geq \pm 10\%$ with 0.01% resolution.

Deviation Accuracy: $\pm (1\% \text{ of full scale} + 2.5\% \text{ of reading})$.

Short Circuit Protection: Output is protected for short circuits of limited duration.

Reference: High quality zener diode.
Temperature coefficient $\pm 0.005\%$ per $^{\circ}$ C.

Temperature Coefficient of Voltage Output (15–35 $^{\circ}$ C):
Better than $\pm 0.015\%$ per $^{\circ}$ C (± 150 ppm/ $^{\circ}$ C).

Line Regulation for +10% line voltage change: $\pm 0.02\%$ max.

Stability: $\pm 0.12\%$ per year (maximum).

TIME SOURCE

Ranges: 2 nsec to 5 second intervals.

- (a) Markers: 10 nsec to 5 sec/div – 24 ranges in 1, 2, 5 sequence.
X1, X2, X5, X10 extends multiplier marker interval to 50 sec.

- (b) Sine Wave: 2 ns (500 MHz) – no deviation.
5 ns (200 MHz) – no deviation.

Sine wave output extendable to 1 GHz with 61251A
Frequency Doubler.

Marker Amplitude:

- (a) 100 nsec/div to 50 sec/div:
 > 0.5 V peak to peak into 50 Ω . 1.0 V peak to peak (typical) into 50 Ω . (1.4 V peak to peak minimum into open circuit.)
- (b) 10, 20 and 50 nsec/div: > 0.5 V peak to peak into 50 Ω .
- (c) 2 and 5 nsec/div: > 0.5 V peak to peak into 50 Ω .

Marker Shape and Width:

- (a) 100 nsec/div to 5 sec/div: Pulse; digitally controlled at mid amplitude to 10% of Time/Div marker interval.
- (b) 10, 20 and 50 nsec/div: Quasi-sinusoidal Pulse; width varies from 40% to 20% of Time/Div marker interval.

2 and 5 ns Output Shape: Sine wave.

Accuracy:

Crystal controlled markers and sine outputs accurate to within $\pm 0.01\%$ of setting.

Crystal (clock) stability: 10 MHz, oven stabilized. Aging rate 3 parts in 10^{-7} per day after 72 hr. warmup.
(See Option 14 for 3 parts in 10^{-9} per day aging rate.)

Note: Clock 10 MHz output (> 250 mV rms) available at rear panel BNC. Also accepts any external clock or signal from 100 kHz to 10 MHz (at 1 V rms into 50 Ω).

Deviation Range (for 10 nsec/div to 5 sec/div markers):
 $\geq \pm 10\%$ with 0.01% resolution.

Deviation Range Accuracy: $\pm 0.2\%$ of full scale.

RISE TIME & TRIGGER OUTPUT

Amplitude: 200 mV to 250 mV continuously variable into 50 Ω (400 mV to 500 mV open circuit).

Risetime: Less than 1 nsec, positive going into 50 Ω .

Period: 0.1, μ sec to 10 seconds (10 MHz to 0.1 Hz in 9 decade steps.)

Waveform: Square Wave. Positive peak at ground reference.

Overshoot: Less than 2%.

Accuracy: Same as Time Source.

LINE FREQUENCY SYNC OUTPUT

Amplitude: Continuously variable from 0 to 1 volt peak-to-peak from max. 2 k Ω source.

Waveform: Follows powerline sine wave. Filtered to remove noise.

GENERAL INFORMATION

Deviation Meter: 3-1/2 digit display with automatic polarity reads out time or voltage deviation to $\pm 10.00\%$. High brightness, four digit, 0.4 inch LED display.

Power Requirements: 100, 120 or 220, 240 rms volts, $\pm 10\%$, 30W, 50 to 400 Hz.

Operating Temperature: 0° C to $+50^{\circ}$ ambient.

Storage Temperature: -50° C to $+85^{\circ}$ C ambient.

Humidity: to 80% RH for full accuracy; to 95% RH operating.

Dimensions: 16–38" wide, 5–1/4" high x 12" deep overall.
(415.6 mm x 133.5 mm x 304.8 mm).

Weight: 16 lbs. (7.0 kg).
31 lbs. (14.2 kg) shipping weight.

Note: All accuracies specified at 23° C $\pm 1^{\circ}$ C with full compensation for output loading and referenced to a standard traceable to NBS with uncertainty of $\pm 0.01\%$.

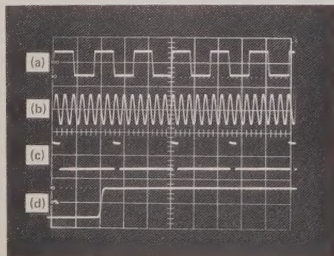
PRICE: 6125B Time and Amplitude Test Set \$1875

OPTION 14

High Stability Time Base. Proportional oven;
 < 3 parts in 10^{-9} per day aging rate after 7 days. \$235

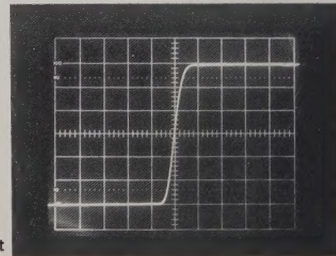
AVAILABLE ACCESSORIES

61251A Frequency Doubler (to 1 GHz) \$125
12630A Feedthrough Termination (50 Ω) \$18



Composite Oscilloscope of 6125B Outputs

- (a) Voltage Calibrator square wave
- (b) Time Calibrator (sine wave)
- (c) Time Calibrator (markers)
- (d) Risetime Calibrator square wave



Typical Risetime Calibrator Output

All U.S.A. sales prices shown are net fob Boonton, New Jersey
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The pulses are in picket fence form and have fast risetimes. The width at the base of each pulse is digitally controlled to 5% of the pulse interval and jitter is normally less than 0.01% of the period.

The sinewave output range provides the faster marker periods of 2 and 5 nanoseconds. These sinewave outputs have no multiplication or deviation facilities. All time calibrations are synchronized to the Risettime Calibrator whose 8 decade repetition rates may be used to trigger the scope at a constant rate when changing time calibration output frequencies. This also permits the scope to be triggered at various repetition rates and a fixed time calibration to check display brightness variation and to check the effects of varying oscilloscope sweep repetition rates on sweep time calibration of any TIME/DIV range.

-4. RISETIME CALIBRATOR

An extremely fast risetime square wave output is provided for risetime measurements. The amplitude is continuously variable over the range 200 to 250 mV (into 50 ohms). There is sufficient adjustment to provide a display of 4 or 5 divisions on oscilloscopes of 10 mV/division without using the oscilloscope variable volts/division control. The risetime is less than 1 nanosecond with extremely flat top to permit amplifier alignment in scopes having greater than 350 MHz bandwidth.

-5. SYNCHRONIZATION/TRIGGER CHECK

A line frequency sinewave output of variable amplitude is available for checking trigger level and trigger slope at line frequency.

MODEL 6125C

EXTERNAL PROGRAM CONNECTOR PIN OUTS

Amplitude Program InputTTL Logic

Volts/Div. Switch	<u>Amplitude Program Connector Pin Number</u>				
	16	17	19	18	4
10 μ V	0	0	0	0	0
20 μ V	0	0	0	0	1
50 μ V	0	0	0	1	0
.1 mV	0	0	1	0	0
.2 mV	0	0	1	0	1
.5 mV	0	0	1	1	0
1 mV	0	1	0	0	0
2 mV	0	1	0	0	1
5 mV	0	1	0	1	0
10 mV	0	1	1	0	0
20 mV	0	1	1	0	1
50 mV	1	0	0	1	0
.1 V	1	0	1	0	0
.2 V	1	0	1	0	1
.5 V	1	0	1	1	0
1 V	1	1	0	0	0
2 V	1	1	0	0	1
5 V	1	1	0	1	0
10 V	1	1	1	0	0
20 V	1	1	1	0	1

<u>Amplitude Program Connector Pin Number</u>	
Local or Remote	15
Remote Overrides Local	1
Local	0

Model 6125C

Amplitude Program Input

TTL Logic

Multiplier	Amplitude Program Connector Pin Number		
	5	21	22
X1	0	0	0
X2	0	0	1
X3	0	1	0
X4	0	1	1
X5	1	0	0
X6	1	0	1
X8	1	1	0
X10	1	1	1

Output Mode	Amplitude Program Connector Pin Number		
	14	1	2
-	1	1	0
GND	0	0	0
+	1	1	1
10 kHz	0	1	0
1 kHz	0	1	1
100 kHz	1	0	0
10 Hz	1	0	1

Deviation Switch	Amplitude Program Connector Pin Number	
	13	
+10% Volts Deviation	1	
OFF	0	

Model 6125C

Amplitude Program Input

TTL Logic

Amplitude Program Connector Pin Number								
Deviation Pot	MSB							LSB
	A1	A2	A3	A4	A5	A6	A7	A8
	7	8	9	10	24	23	12	11
Max.	0	0	0	0	0	0	0	0
Negative								
Deviation								
(<-10%)								
Max.	1	1	1	1	1	1	1	1
Positive								
Deviation								
(>+10%)								

Pin #	
3	$\frac{1}{///}$ (GND)
6	+5V

Model 6125CTime Program InputTTL Logic

TIME/Div Switch Setting	Time Program Connector Pin Number					
	21	22	24	23	18	19
10 ns	1	1	1	1	0	0
20 ns	1	1	1	1	0	1
50 ns	1	1	1	1	1	0
.1 μ s	1	1	1	0	0	0
.2 μ s	1	1	1	0	0	1
.5 μ s	1	1	1	0	1	0
1 μ s	1	0	0	0	0	0
2 μ s	1	0	0	0	0	1
5 μ s	1	0	0	0	1	0
10 μ s	0	0	0	0	0	0
20 μ s	0	0	0	0	0	1
50 μ s	0	0	0	0	1	0
.1 ms	0	0	0	1	0	0
.2 ms	0	0	0	1	0	1
.5 ms	0	0	0	1	1	0
1 ms	0	0	1	0	0	0
2 ms	0	0	1	0	0	1
5 ms	0	0	1	0	1	0
10 ms	0	0	1	1	0	0
20 ms	0	0	1	1	0	1
50 ms	0	0	1	1	1	0
.1 sec	0	1	0	0	0	0
.2 sec	0	1	0	0	0	1
.5 sec	0	1	0	0	1	0
1 sec	0	1	0	1	0	0
2 sec	0	1	0	1	0	1
5 sec	0	1	0	1	1	0

Time Program Input

TTL Logic

Local or Remote Setting	Time Program Connector Pin Number	
	20	
Remote Overrides	1	
Local		
Local	0	

TIME/DIV Multiplier Switch Setting	Time Program Connector Pin Number	
	16	17
X1	1	1
X2	0	1
X5	1	0
X10	0	0

TRIGGER PERIOD Switch Setting	Time Program Connector Pin Number		
	12	11	9
100 ns	1	1	1
1 μ s	0	0	0
10 μ s	0	0	1
100 μ s	0	1	0
1 ms	0	1	1
10 ms	1	0	0
100 ms	1	0	1
1 sec	1	1	0

Time Program Input

TTL Logic

Time Program Connector Pin Number								
Deviation Switch	10							
+10% Time Deviation	1							
OFF	0							
	MSB							LSB
Deviation	A1	A2	A3	A4	A5	A6	A7	A1
Pot	1	14	13	15	2	3	4	5
Max. Negative Deviation (<-10%)	0	0	0	0	0	0	0	0
Max. Positive Deviation (> +10%)	1	1	1	1	1	1	1	1
Pin #								
6	+5V							
7	$\left(\frac{1}{///}\right)$ GND							

SECTION II

PREPARATION FOR USE AND SHIPMENT

GENERAL.

This section contains information and instructions necessary for installation and reshipment of 6125B/C Time and Amplitude Test

Details are provided for inspection, performance checks, connections, grounding safety requirements, installation information, and repacking instructions for storage or shipment.

UNPACKING AND INITIAL INSPECTION.

Unpacking and initial inspection of the generator require only normal precautions and procedures applicable to the handling of sensitive electronic equipment. The contents of all shipping containers should be checked for included accessories and certified against the packing slip to ascertain the shipment is complete.

PERFORMANCE CHECKS.

This instrument was carefully inspected for mechanical and electrical performance before shipment at the factory. It should be free of physical defects and in acceptable operating condition upon receipt. Inspect the instrument for possible damage incurred while in transit. Complete the performance checks beginning with paragraph 4-6. If there is any indication of damage or improper operation, refer to the warranty included in this manual, notify the manufacturer or the manufacturer's field representative.

POWER REQUIREMENTS.

2-8. The generator may be operated from an ac voltage source rated at 100, 120, 220, or 240 volts rms at 50 to 400 Hz. The orientation of the printed circuit board in the ac power connector on the rear of the instrument matches the instrument to the ac voltage source. See Figure 2-1.

CAUTION

Failure to orient the printed circuit board properly will damage the instrument and void the warranty.

2-9. The instrument should be operated from a power source with its neutral at or near ground (earth) potential. The instrument is not intended for operation from two phases of a multiphase ac system or across the legs of a single-phase, three-wire ac power system. Crest factor (ratio of peak voltage to rms) should be typically within the range of 1.3 to 1.6 at $\pm 10\%$ of the nominal line voltage. Use a true rms responding voltmeter, such as the Ballantine Model 3620A, to measure the power line voltage.

2-10. GROUNDING REQUIREMENTS.

2-11. To insure the safety of operating personnel, the U.S. Occupational Safety and Health Act (OSHA) and good engineering practice require that the instrument panel and enclosure be "earth" grounded. All Ballantine instruments are provided with a three-conductor power cable assembly which, when plugged into an appropriate power receptacle, grounds the instrument. The offset pin on the male end of the power cable is the ground wire connection to the connector on the rear panel of the instrument.

2-12. To preserve the safety protection feature, when operating the instrument from a two-contact power outlet, use a three-prong to two-prong adapter and connect the green lead or terminal on the adapter to "earth" ground.

WARNING

When using an external dc power source, or with internal battery operation, there is no ground return through the power cord. Take care to avoid electrical shock; also, consider connecting the instrument cabinet to earth ground through the rear-panel, ground post.

2-13. INSTALLATION AND MOUNTING

2-14. GENERAL. The generator is fully solid state and dissipates minimal heat. No special cooling is required; however, the instrument should not be operated where the ambient temperature exceeds 55°C (131°F) or when condensation due to high humidity appears anywhere on the instrument.

2-15. BENCH MOUNTING. The generator is shipped with plastic bumper-feet and metal tilt-stand in place, ready for use as a bench instrument. Outline dimensions are shown in Figure 2-2.

2-16. RACK MOUNTING. The generator may be rack-mounted in a standard 19-inch EIA rack. Allantime P/N , is

required to provide rack-mount side brackets. Before installing the instrument in the rack, remove the plastic bumper-feet and tilt stand. Do not discard these items, but store them for future use.

2-17. PROTABLE USE. The instrument as supplied includes a side carry-handle.

2-18. SHORT TERM STORAGE.

2-19. If the instrument is to be stored for a short period of time (less than three months), place cardboard over the panel and cover the instrument with a suitable protective covering, such as a plastic bag or strong, draft paper. Place power cable and other accessories with the instrument. Store the covered instrument in a clean, dry area that is not subject to extreme temperature variations or conditions which may cause moisture to condense on the instrument.

2-20. LONG TERM STORAGE OR REPACKAGING FOR SHIPMENT.

2-21. If the instrument is to be stored for a period longer than three months, or if it is to be repackaged for shipment, as a general guide, repackage the instrument as described in the following procedure and shown in Figure 2-3.

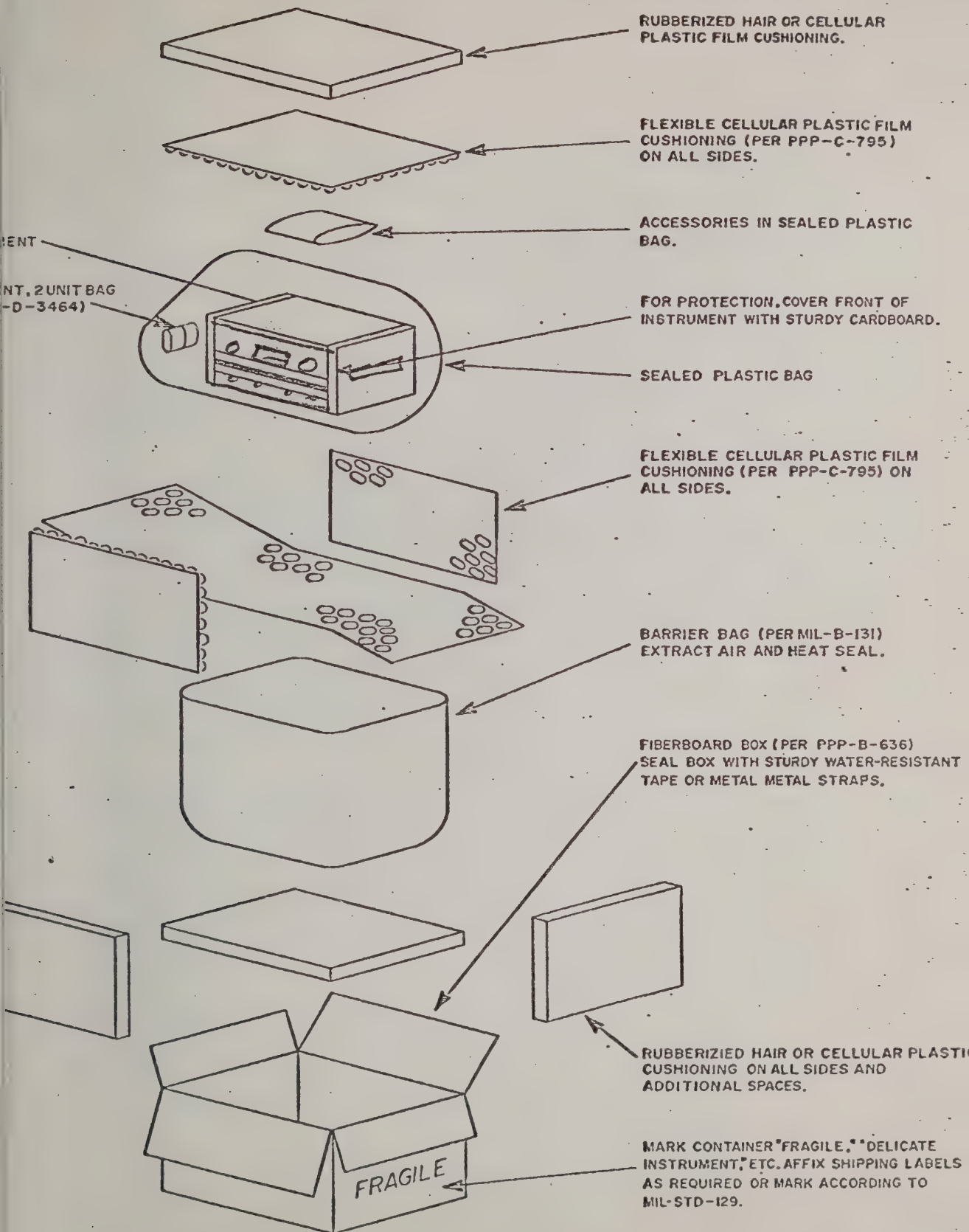


Figure 2-3. 6125B/C Time and Amplitude Test Packing Diagram.

Use either the original packing material, if available, or material similar to that specified. Proceed as follows:

a. Place the instrument accessories, if any, in a plastic bag and seal the bag.

b. For long distance shipping only, use U.S. Government packaging method IIC and tape a two-unit bag of dissicant (MIL-D-3464) on the rear cover.

c. Place a piece of sturdy cardboard over the front panel for protection. Enclose the instrument in a plastic bag and seal the bag.

d. Wrap the bagged instrument and accessories in a 1-inch thick, flexible, cellular plastic-film, cushioning material (PPP-B-795) and place in a barrier bag (MIL-B-131). Extract the air from the bag and heat seal.

e. Place the wrapped instrument and accessories into a fiberboard box (PPP-B-636) of suitable size. Fill spaces with rubberized hair or cellular plastic cushioning material. Close the box in accordance with container specifications. Seal with sturdy, water-resistant tape or with metal straps.

f. Mark container "FRAGILE," "HANDLE WITH CARE," or similar precautionary notice. Affix shipping labels as required or mark in accordance with MIL-STD-129.

NOTE

If the instrument is to be returned to Ballantine Laboratories, Inc. for calibration or repair, attach a tag to the instrument identifying the owner; also, note the problem, symptoms, and service or repair desired. List the model and serial number of the instrument. Ship the instrument prepaid to Ballantine Laboratories, Inc., 90 Fanny Road, Boonton, New Jersey 07005, U.S.A. In any correspondence, identify the instrument by model number, serial number, work authorization order, and state and method of shipment.



Ballantine Laboratories, Inc.

PRINCIPLES OF OPERATION

VOLTAGE CALIBRATOR

INTRODUCTION: The basic voltage calibrator circuit consists of a Resistance Programmable regulated power supply, a high voltage low impedance transistor switch circuit, and a precision resistor multi-range attenuator. The combination of resistance programming of the power supply and range selection of the attenuator provides calibrated voltages from 200V down to 10 uv in 1, 2, 5 steps. The output voltage may be positive or negative D.C., or positive square waves of 10, 100, 1000 or 10000 Hz as determined by mode selection circuits. A deviation circuit permits calibrated, metered deviation of the output voltage from nominal, for direct reading deviation measurements. Model 6125C, in addition to the above features, provides local or remote programming of all output modes in ranges and deviation.

CIRCUIT DESCRIPTION

PROGRAMMABLE POWER SUPPLY

The power supply regulator is a voltage follower circuit whose input reference voltage E is determined by the current flowing through programming resistance R . If the current is supplied from a constant current source I then the reference voltage and the output voltage is linearly proportional to R except for very small errors introduced by the finite gain of the difference amplifier. The front panel MULTIPLIER switch changes the value of R in calibrated steps to produce the $X1$ through $X10$ steps.

When the DEVIATION mode is selected, another variable source of current is provided through resistance R_D . This variable or deviation current is equal to $\frac{E_D}{R_D}$ and the output voltage deviation is, therefore,

$E_D \frac{R_D}{R}$. Since R_D and R are fixed on any particular range, the meter measurement of E_D is a direct measurement of ΔE in the percentage expression $\frac{\Delta E}{E} \times 100$ and the meter can be calibrated accordingly.

TRANSISTOR SWITCH, DRIVER and SQUARE WAVE COUNTER

The Transistor Switch has a single pole double throw configuration in which Q1 is saturated when Q2 is off thus connecting the output attenuator to the H1 LINE bus, or Q1 is off when Q2 is saturated thus connecting the attenuator to the low line bus. Q3 amplifies the drive to Q1 while Q2 is driven directly from the Driver circuit. The driver circuit consists of an optical coupler driving a transistor amplifier. The optical coupler provides isolation between the "noisy" square wave frequency counter circuitry and the Lo Line bus of the output attenuator, helping to reduce noise coupling on the low level ranges. The optical coupler is driven by an emitter follower from either a d.c. voltage in the D.C. mode, or square waves counted down from a frequency source in the time mark generating circuits. The counter is a programmable multi-decade IC counter (MK5009).

ATTENUATOR

The attenuator is a precision resistive divider with the taps connected to the output through relay contacts in order to provide remote programming capabilities. On the lower output voltage ranges a 100:1 divider A_R_ thru A_R_ is inserted in series with the basic divider chain.

REMOTE PROGRAMMING OPTION

Remote programming capability of all ranges and most functions was one of the initial design requirements for the 6125. Accordingly in the model 6125C this capability is provided through a 40 pin connector on the rear panel with low power Schottky TTL input interfacing. The input coding for the various ranges and functions are given in Tables 1 thru ____.

OUTPUT MULTIPLIERS

to produce 5 ns and 2 ns markers, the 100 MHz oscillator output is amplified and used to drive tuned harmonic multipliers. In the case of the 5 ns marker circuit a push-pull doubler stage drives a transformer primary tuned 200 MHz and the secondary couples the signal to the output. The 2 ns marker circuit emphasizes the fifth harmonic energy in the 100 MHz square wave input through tuned circuits and a nonlinear varactor diode. The 500 MHz signal is amplified by a high frequency transistor A with output tuning via a 500 MHz 1/4 wave length stripline.

TRIGGER CIRCUIT AND FAST RISE OUTPUT

Trigger periods from 100 ns to 1 sec are derived by selecting the desired trigger rate from the counter chain with a digital multiplexer. To ensure that the edges of the trigger signal are coincident with the positive edge of the marker signal at all ranges, the trigger signal is clocked into a Type D flip-flop with positive edge clocking using the marker signal as the clock. On some ranges this can produce slightly asymmetrical trigger signals, so for those applications where a symmetrical output from the TRIGGER OUT connector is required a switch is provided to bypass this coincidence circuit. In either case this signal is then applied to an amplifying and clipping circuit to produce a very fast (<1 ns) rise time edge for the trigger signal for use in calibrating rise times in wide band oscilloscopes. The fast edge is produced by driving the common base output transistor into cutoff with a large, high rate of rise signal from the previous amplifier stages. Damping resistors and capacitors are added in critical areas to minimize ringing and crosstalk.

DEVIATION CIRCUIT

The deviation circuit is located on the A18 TIME/VOLTS DEVIATION control assembly board. The time deviation circuit is a typical frequency measuring circuit using counting techniques. Pulses of constant amplitude and width are integrated to provide a dc output for the digital meter which is calibrated in percent frequency deviation.

A sophisticated pulse counting frequency deviation circuit is used rather than simply measuring the dc frequency deviating voltage from the time DEVIATION control which is applied to A14U1, the 100 MHz voltage controlled oscillator (VCO). The modulation transfer characteristic of VCO A14U1 is not linear so that reading the frequency shifting dc voltage would not provide an accurate measure of DEVIATION. The pulse counting circuit used overcomes the problem of accuracy since it has the required precision. In the 6125C, remote programming time DEVIATION is accomplished through A10U4 the 8 bit digital to analog converter. Stepping this D to A converter will not give proportional percentage time deviation which is accurately read by the digital deviation meter on the front panel. Nevertheless, the transfer characteristic from the digital input to the D to A converter is sufficiently stable that the digital programmer may include a simple look-up table which will provide a direct digital command of percentage deviation.

18U1 is decade divider which takes the 10 MHz clock derived from the internal crystal oscillator and divides it by ten to obtain a 1 MHz square-wave (1 μ s period) reference. A 18U3 (Q3) is a type D flip flop which subtracts the variable frequency is normally in the range of 900,000 Hz to 1,100,000 Hz which represents 10% frequency deviation.

18U3 is the second stage of the shift register. It reproduces the output of 18U5 delayed by one period of the variable input frequency.

The connections from power AND gates A18U2(Q8 and Q9), from A18U3(Q5) and 18U3(Q6) provide a pulse whose width equals one period of the variable input frequency and whose pulse repetition frequency is difference frequency between the variable input and the 1 MHz reference. Assume that logical "ones" are present at the other two inputs to A18U2 for the duration of this pulse. The output of the AND gate is the free collector of a grounded emitter transistor. When the pulse is present, current will flow from the +5 volt supply through the DEVIATION switch and resistor networks A18R6, A18R10, A18R8 and A18R12. This current must flow through A18C1 which acts as a filter. A18C1 is connected across A17R1 which is a 200 ohm resistor acting as a current shunt for the input to the digital deviation meter. A18C1 is sufficiently large so that only the average component of the pulsed current activates the digital meter. Therefore, the pulse width multiplied by pulse repetition frequency is proportional to the digital meter current and the parameters are so chosen that meter current is proportional to the percentage deviation of the period of the pulse repetition frequency.

Clarity information is provided by A18U5(Q3). A18U5(Q2) provides an output at the frequency of the variable input but shifted 90 degrees with respect to the input. A18U4(Q3) subtracts the shifted signal from the 1 MHz reference frequency. Therefore, when A18U3(Q5) generates a pulse which will open either AND gate in A18U2(Q7 or Q8) depending whether the variable input frequency is higher or lower than the 1 MHz reference.

With very small deviation between the 1MHz reference and the variable input frequency there could be some instability of the digital meter which may somewhat follow low frequency normal mode input signals. This apparent meter instability is avoided by clocking A18U4(Q4) on the negative edge of the signal provided by A18U3. A18U2 reads the A18U4(Q5) and A18U4(Q3) by inverse connection. Therefore, both AND gates in A18U2 are cut off. A18U4(Q3) changes after A18U3(Q5) falls. This clocking assures that only one output pulse exists for each cycle of the variable input frequency.

TIME CALIBRATOR

INTRODUCTION

The Time Calibrator has a basic reference, a 10 MHz crystal controlled oscillator. All other frequencies are derived from this reference by multiplication, division or phase locked loop techniques. The reference frequency is first used to phase lock a 100 MHz voltage controlled oscillator. The 100 MHz oscillator is multiplied by 2 and 5 to provide 5 ns and 2 ns output markers and is also divided in a 1, 2, 5, 10 sequence to provide markers with periods from 10 ns to 50 sec. A square wave trigger source with periods ranging from 100 ns to 1 sec is also provided. The square wave rise time is less than 1 ns permitting rise time checks of wideband amplifiers. A deviation measuring circuit provides direct reading time deviation measurements on all ranges except the 2 and 5 ns outputs. Remote programming of all ranges except the 2 ns and 5 ns outputs and all functions except the trigger amplitude are provided in the Model 6125C.

100 MHz OSCILLATOR

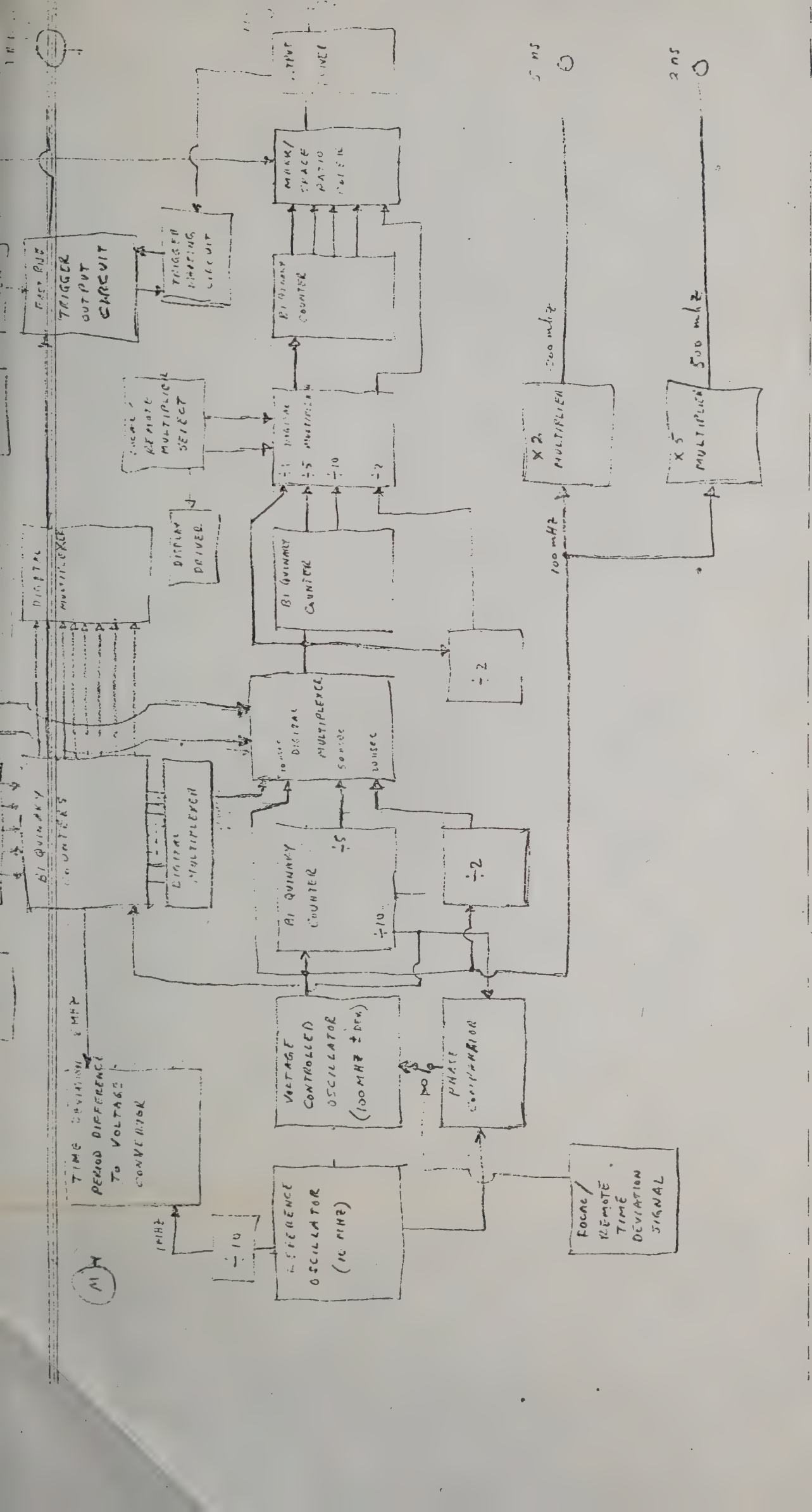
The 100 MHz oscillator is a voltage controlled oscillator which is phase locked to the 10 MHz reference crystal oscillator except when the deviation mode is selected. The oscillator is a Motorola MECL IC Type 1658 and as stated in the data sheets - frequency control is accomplished through the use of voltage-variable current sources which control the slew rate of a single external capacitor. In the calibrated mode the output of the VCO is applied to a decade counter (MC 10138) and the resultant 10 MHz output is phase compared to the 10 MHz crystal reference in a Motorola MC 4044 Phase Frequency Detector. The output of the phase detector is then applied to the voltage control input of the MC1658 to complete the phase locked loop and ensure that the 100 MHz oscillator frequency is as accurate and stable as the 10 MHz crystal reference except for some second order short term jitter. In the deviation mode the voltage control input of the oscillator is switched to a variable voltage source which is controlled by a front panel potentiometer for local programming or by a D/A converter for remote programming.

COUNTER CHAIN AND MULTIPLEXING

The 100 MHz oscillator frequency is counted down in 1, 2, 5, 10 steps by a number of bi-quinary counters and binary flip-flops. From 10 ns periods to 50 ns periods ECL devices are used while from .1 μ s to 5 sec, low power Schottky TTL is used. For a given range, digital multiplexers then route the particular timing signal required to the output circuits for processing and shaping. One additional bi-quinary and binary counter and digital multiplexer provides 1, 2, 5 and 10 times multiplication of the time period selected by the range switching.

MARK/SPACE RATIO ENCODER AND OUTPUT DRIVER

The marker outputs have a mark/space ratio of 5% on all ranges except the 10 and 50 ns ranges which have a 50% ratio and the 50 ns range which has a 20% mark/space ratio. The 5% mark/space ratio is produced by NORing .05T, .1T, .2T, .5T and T signals. Since all the signals are low for only 1/20 of the time period, the mark is 1/20th of T or 5%. This signal which is at MECL levels drives a differential amplifier stage which amplifies and sharpens the signal and also translates the baseline to zero volts at the emitter of the output emitter follower.



Q5, C6

Q2, C3

Q3

Q3, D4

Q5, D6

Q6

Q6

Q5, Q6, Q2, Q4

Q5, Q6, Q3, Q4

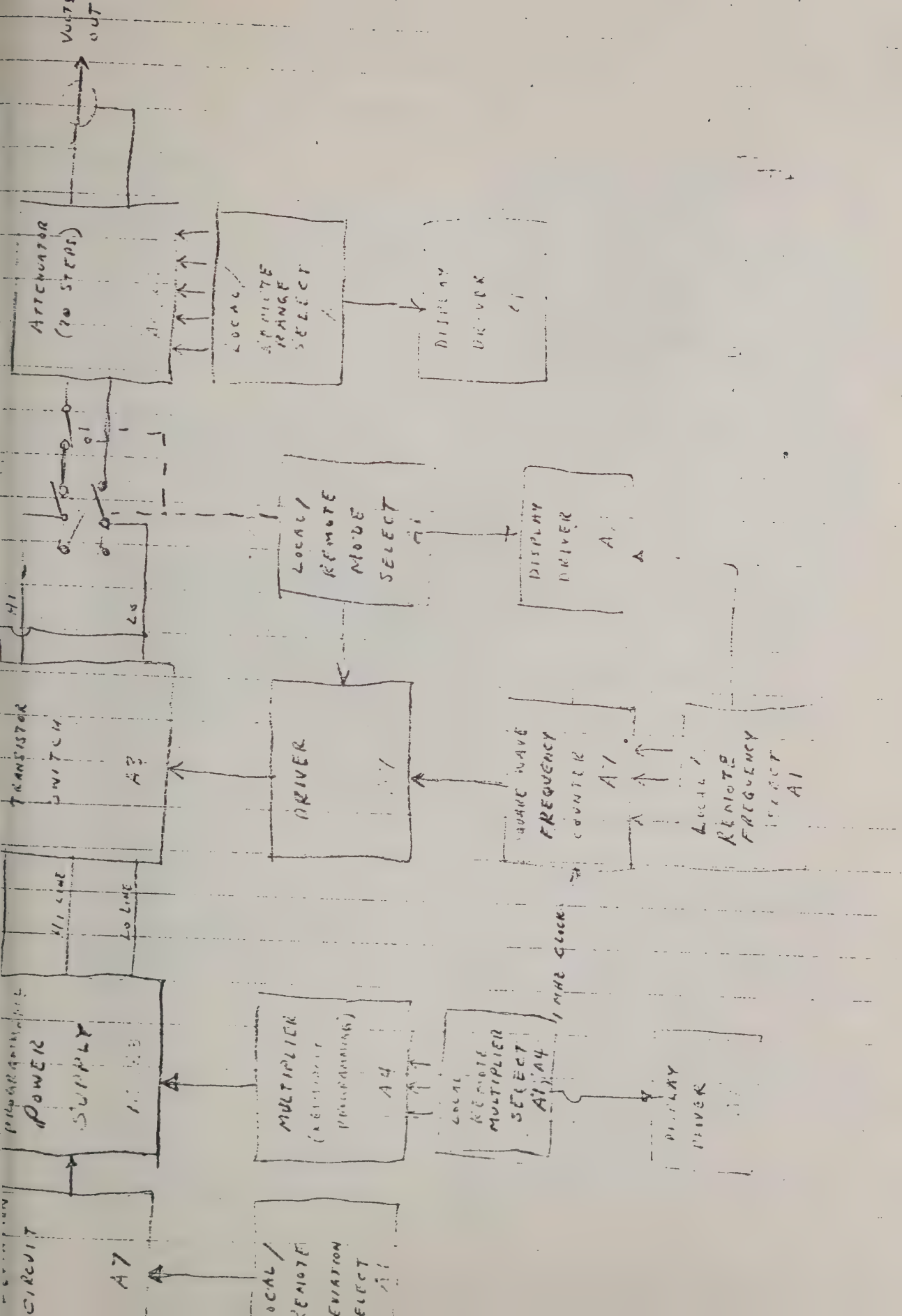
Q5, C4

Q4

Q4

Timing Diagram of REFLECTION

Deviation = (-ΔT)



SECTION IV

OPERATION AND PROGRAMMING

4-1 INTRODUCTION.

4-2 This section contains instructions and information required for the operation of the instrument. Included are identification of controls, connectors, indicators and programming of the 6125C.

4-3 CONTROLS, INDICATORS, AND CONNECTORS.

4-4 The controls, indicators, and connectors for the 6125B and 6125C are identified in Figure 4-1 thru Figure 4-4 and Table 4-1.

4-5 POWER REQUIREMENTS.

4-6 See Paragraphs 2-7 through 2-9. For grounding and safety earth connections, see Paragraphs 2-10 through 2-12. Always check rear panel voltage selector switch in the power receptacle. Failure to apply the correct ac power mains voltage may cause serious damage to the instrument and will void the warranty.

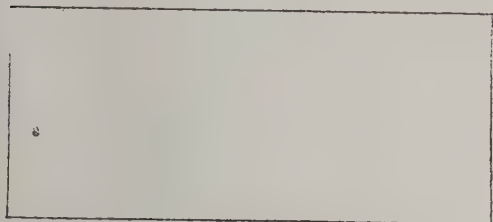


Figure 4-1. Model 6125B Front Panel Controls, Indicators, and Connectors.

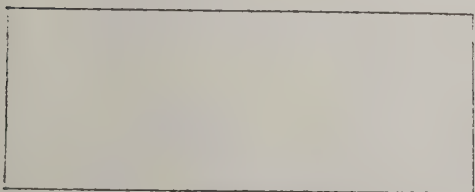


Figure 4-2. Model 6125B Rear Panel Controls and Connectors.

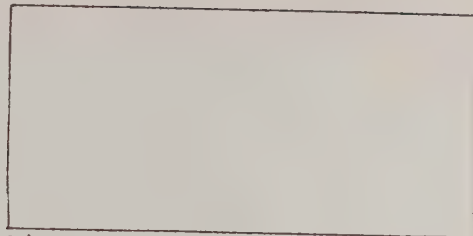


Figure 4-3. Model 6125C Front Panel Controls, Indicators, and Connectors.

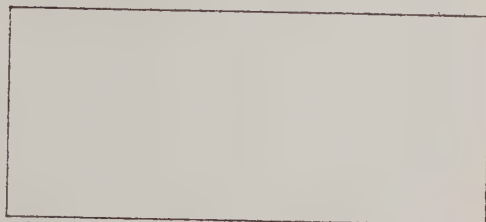


Figure 4-4. Model 6125C Rear Panel Controls and Connectors.

4-7 OPERATING INSTRUCTIONS.

4-8 Turn power on by setting the power toggle switch to ON.

4-9 Output Connections.

4-10 Six BNC output connectors are provided.

a. LINE FREQ - Continuously variable 0 to 1 volt peak-to-peak sine wave at power mains frequency. Used for activating AC voltmeter ranges and for qualitatively checking oscilloscope trigger circuits for slope, trigger leveling and line frequency operation.

b. VOLTS-OUT - Provides accurate dc voltage with positive or negative polarity. Zero check and four positive going square wave outputs of 10 Hz, 100 Hz, 1 kHz and 10 kHz are also provided.

The square wave outputs may be used to check true rms ac voltmeters, to com-

Table 4-1. Operating Controls, Indicators and Connectors.

compensate attenuators, calibrate the amplitude of oscilloscopes and to check the response of input coupling filters and check solid-state dc amplifier thermal drift compensation. Amplitude deviation capability of $\pm 10\%$ is provided.

c. 5 nS HF OUTPUT - Provides 200 MHz sine wave output from a 50 ohm source impedance.

d. 2 nS HF OUTPUT - Provides 500 MHz sine wave output from a 50 ohm source impedance.

e. MARKER OUT - Provides outputs from 10 nS to 50 seconds in 1, 2, 5 steps. The associated MULTIPLIER provides time multiplication of these markers by X1, X2, X5 and X10 to simplify time calibration of oscilloscopes and digital counters. Time deviation capability of $\pm 10\%$ is provided.

f. TRIG OUT - Provides an output square wave with a rise time of less than 1 nanosecond into 50 ohms. The square wave amplitude is continuously variable from 200 to 250 mV. The square wave period is variable from 1 second to 100 nanoseconds (frequency of 1 Hz to 10 MHz) in eight decade steps. An internal MARKER-TRIGGER INTERLOCK switch may be set to LOCKOUT to provide gated time coincidence between markers and triggers whenever the trigger period is longer than the marker period. In the LOCKOUT mode, the TRIG OUT signal will be automatically shut off when the TRIGGER period is equal to or shorter than the marker period.

-11 VOLTAGE CALIBRATION.

-12 DC VOLTAGE OUTPUT.

-13 The VOLTS OUT BNC provides an accurate DC voltage of either positive or negative polarity or zero output as selected by the OUTPUT mode switch. This dc output voltage may be used to

calibrate analog and digital dc voltmeters and other dc level sensitive circuits. A typical test condition is illustrated below.

4-14 Check or Calibrating a DC Voltmeter.

a. Check the voltmeter to be tested to be sure it is functioning properly and that its specified accuracy is commensurate with the $\pm 0.25\%$ of setting accuracy of the 6125B/C. The input resistance of the voltmeter under test should be 1 megohm or higher to avoid loading the 6125B/C and disturbing the accuracy of the measurement.

b. Set the voltmeter controls as follows:

Range:	Highest Voltage Range
Mode:	DC Voltage
Polarity:	Positive (or automatic)

c. Set the 6125B/C controls as follows:

VOLTS/DIV	10 μ V
OUTPUT MODE	DC +
MULTIPLIER	X10
DEVIATION	OFF

d. Connect the input of the voltmeter under test to the VOLTS OUT BNC of the 6125B/C. Connect the + or HI input connector of the voltmeter to the center pin of the VOLTS OUT BNC and the voltmeter common (LO or -) terminal to the BNC shell. Use short twisted leads or a shielded cable to interconnect the voltmeter to the 6125B/C.

e. Rotate the VOLTS/DIV switch counter clockwise until the voltmeter under test reads approximately full scale. Note that the VOLTS/DIV setting is one tenth the full range setting of the voltmeter since the MULTIPLIER switch is set to increase the VOLTS/DIV potential by X10.

f. Set the DEVIATION switch to VOLTS $\pm 10\%$ and observe that the volts DEVIATION lamp is illuminated.

g. Rotate the VOLTS/DIV DEVIATION control (concentric with the VOLTS/DIV switch) until the voltmeter under test reads exactly full range indication. Note the reading of the digital DEVIATION meter on the 6125B/C; it represents the calibration error of the voltmeter under test.

h. Check the accuracy specification of the voltmeter under test. Accept the calibration if the 6125B/C deviation meter reading is less than the allowable error. If the deviation percentage is greater than the voltmeter's specified calibration error, the voltmeter is out of calibration and should be repaired and recalibrated.

i. When recalibrating the voltmeter under test, set the 6125B/C DEVIATION switch to OFF. Set the proper output voltage of the 6125B/C with the VOLTS/DIV switch and the volts MULTIPLIER. Adjust the voltmeter's calibration control for an exact voltmeter indication of the output voltage of the 6125B/C.

j. Decading Check. To check voltmeter decading, simply set the VOLTS/DIV MULTIPLIER switch from X10 to any of the other seven cardinal points. Check accuracy of the voltmeter under test at any of these points and determine calibration error as a percent of reading by using the 6125B/C VOLTS DEVIATION control. Proceed at each point as detailed above in paragraphs f, g and h.

4-15 SQUARE WAVE VOLTAGE OUTPUT.

4-16 The VOLTS OUT BNC provides an accurate zero based positive going square wave for amplitude, gain, and attenuator compensation in oscilloscopes, digital counters, amplifiers,

and instrumentation systems. The OUTPUT MODE switch permits selection of four square wave frequencies - 10 Hz, 100 Hz, 1 kHz and 10 kHz.

4-17 Checking or Calibrating Oscilloscope Vertical Amplitude and Attenuator Compensation.

4-18 VOLTAGE MEASUREMENT ERRORS.

4-19 Loading Errors.

4-20 The VOLTS OUT accuracy is specified into an open circuit. Very small errors are caused by load impedances over 100 K Ω since the source OUTPUT impedance of the VOLT OUT is very low. Changing the VOLTS/DIV MULTIPLIER setting will not materially change the output impedance or the loading error. See Table 4-3 for loading error tabulations. Note that 1 megohm load cause negligible errors on most ranges but approach the 6125B/C 0.25% accuracy on the 10V, 5V, 10 mV and 5 mV ranges. 10 megohm loads cause errors too small that they may be ignored within the basic 6125B/C accuracy. Most modern digital voltmeters and oscilloscope attenuator probes represent 10 megohm loads and can be assumed not to contribute to loading errors. Loads less than 1 megohm should be avoided if the basic 6125B/C accuracy is to be maintained, although loading error may be corrected by the following computation:

a) Determine the resistance of the load.

b) Look up the 6125B/C VOLTS/DIV range source output resistance in Table 4-3.

VOLT/DIV RANGE	OUTPUT RESISTANCE	% ERROR	
		1 M Ω LOAD	10 M Ω LOAD
20 V	220 Ω	-.022%	-.002%
10 V	2.72 K Ω	-.272%	-.027%
5 V	2.09 K Ω	-.209%	-.021%
2 V	1.12 K Ω	-.112%	-.011%
1 V	695 Ω	-.070%	-.007%
5 V	463 Ω	-.046%	-.005%
2 V	319 Ω	-.032%	-.003%
1 V	270 Ω	-.027%	-.003%
50 mV	245 Ω	-.025%	-.003%
20 mV	320 Ω	-.032%	-.003%
10 mV	2.72 K Ω	-.272%	-.003%
5 mV	2.09 K Ω	-.209%	-.021%
2 mV	1.12 K Ω	-.112%	-.011%
1 mV	495 Ω	-.070%	-.007%
5 mV	463 Ω	-.046%	-.005%
2 mV	319 Ω	-.032%	-.003%
1 mV	270 Ω	-.027%	-.003%
50 μ V	245 Ω	-.025%	-.003%
20 μ V	230 Ω	-.023%	-.002%
10 μ V	225 Ω	-.023%	-.002%

TABLE 4-3. VOLTS OUTPUT LOADING ERROR

c) Calculate loading error

$$\% \text{ loading error} = \frac{100 \times \text{Source Output Resistance}}{\text{Source Output Resistance} + \text{Load Resistance}}$$

4-21. DC OFFSET ERRORS.

4-22. At VOLTS/DIV switch settings above 50 mV, the output attenuator resistors must dissipate sufficient power to produce heat in the wire-wound resistors. This heat differential is especially noticeable on the DC+ and DC- modes where the attenuator dissipates twice the power of the squarewave output mode and when using the X5, X6, X10 setting of the MULTIMETER. The heating in the attenuator will result in thermoelectric effects which cause offsets of a few microvolts on the low level ranges of the VOLTS/DIV switch.

Always allow a waiting period of 3 to 5 minutes before using the low voltage output if the VOLTS/DIV switch has been set to ranges between 50 mV and 20 V.

This assures the temperature in the attenuator to equalize so as to minimize errors caused by thermoelectric effects.

Use the GND mode to provide zero voltage reference for voltmeters or oscilloscopes. Do not use the switch on the oscilloscope itself or otherwise short the input terminals of the voltmeter under test.

Using the GND mode eliminates most of the remaining thermal effects in the attenuator of the 6125B/C or the interconnections to the voltmeter or oscilloscope under test. The voltmeter reading with GND input represents the thermal voltage of the 6125B/C the connecting leads and the voltmeter. The GND reading is the minimum voltage of the entire measurement system and it must be measured and arithmetically added to the reading of the voltmeter for all calibrations below ± 10 mV. On some 6125B/C a front panel screwdriver control will permit cancelling the thermal voltage effects within their normal range of ± 100 μ V.

4-22. GROUND CURRENT ERRORS.

4-23. Always ground the power cord ground pins on the calibrator and the instrument under test to earth ground. This is especially important to avoid noise interference on low VOLTS/DIV ranges. The VOLT OUT circuitry is offset ground by internal resistor R which is used to avoid circulating ground loop currents between the VOLTS OUT connector shell and the instrument under test. When using VOLTS/DIV ranges below 0.1 volt and the calibration is suspect or displays power frequency distortion, carefully check the instrument for input power circuit leakage problems. If the instruments are found safe, it is recommended that one or the other instrument be temporarily isolated from the power mains earth ground and that a well shielded and safe isolation transformer be used in its power input. This will remove or reduce circulating ground currents so that errors from this source may be minimized for low output voltage level applications.

WARNING

Disconnecting earth grounds may provide a personnel safety hazard in some instruments. Use extreme caution to avoid shock hazard and restore normal earth ground once low voltage calibrations are completed.

4-24. WARMUP ERRORS.

4-25. The unit is fully operative within one minute of POWER turn ON. The amplitude calibration drift during the first 20 minutes of operation in a constant temperature laboratory environment is less than ± 0.2 percent in normal or subsequent operation.

4-26. TIME CALIBRATION.

-27. TIME MARK GENERATOR.

-28. The MARKER OUT BNC is an accurate time signal in the shape of a pulse train. The positive going pulses occupy 5 percent of the marker period for intervals longer than 0.1 μ s and approximately a square wave at 10 nanoseconds. The TIME/DIV MULTIPLIER permits decading checks as well as oscilloscope magnifier check andicket fence simulation in radar range calibration. Digital counters and signal sources may also be checked. The markers are rich in harmonics. They may be used to check spectrum analyzers. An external time base input provision permits use of 10 MHz frequency standard for traceable calibrations. The EXT clock input may be used to provide arbitrary TIME/DIV marker output selection below 0.1 μ s (10 MHz) s may be required for video markers, ultrasonic delay calibration and engineering unit readouts. A typical test procedure for oscilloscopes is illustrated below,

-29. Checing Oscilloscope Time Base Calibration.

-30. Connect the MARKER OUT BNC connector of the 6125B/C to the vertical amplifier of the oscilloscope to be tested. Use a 50 ohm coaxial cable terminated in 50 ohms at the input BNC of the oscilloscope. The Ballantine Model 12249D four foot BNC/BNC Cable and the Model 12630A 50 ohm Feed Thru Termination is recommended.

-31. Set the 6125B/C controls as follows:

TIME/DIV	Same as the oscilloscope TIME/DIV range to be checked.
MULTIPLIER	X1
DEVIATION	OFF

-32. Set the oscilloscope vertical attenuator to 0.1 VOLT/DIV and adjust the scope trigger circuits for proper internal triggering when the oscilloscope TIME/DIV switch and the 6125B/C TIME/DIV switch are set to the same range.

4-33. Use the oscilloscope position controls and properly center the display on the CRT. Figure 4- shows a typical presentation. Note that ten time intervals are defined on an approximately 5 division high display.

4-34. Position the first rise to the left most graticule line. Observe that one calibration marker falls on each graticule line. The error of marker alignment on the eleventh (right most) graticule line represents the observed calibration error.

4-35. Set the DEVIATION switch to TIME $\pm 10\%$ and note that the TIME/DIV deviation indicator lamp is illuminated. Rotate the TIME/DIV deviation control until the right hand marker pulse aligns with the right hand graticule line and a marker falls on each graticule line of the scale.

4-36. Read the % DEVIATION digital meter on the 6125B/C and note the measured error for the oscilloscope time base range under test. If this is within the oscilloscope calibration error allowance (usually $\pm 3\%$) proceed; if not, note the error and recalibrate the oscilloscope.

4-37. Observe the alignment of the leading edge of the marker on the second thru the tenth graticule lines. This is an indication of time base linearity.

4-38. Continue to check calibration accuracy of all the time base ranges of the oscilloscope under test. TIME/DIV settings slower than 1 ms may be easier to check when the TIME/DIV MULTIPLIER is set to X5 and even X10 for the slowest sweeps.

NOTE

Use triggered sweep synchronization for all TIME/DIV settings slower than 1 ms. Do not use AUTO triggering, since erratic synchronization for slow pulse rates will result in misalignment of the first marker pulse with the first CRT graticule line.

4-39. HF OUTPUTS.

4-4b. For time calibration signals of 5 nanoseconds and 2 nanoseconds, the 6125B/C provides independent 200 MHz and 500 MHz sinewave outputs derived from the same master clock as the MARKER OUT and TRIG OUT signals. The 200 MHz and 500 MHz HF OUTPUTS are generated by frequency multiplication. Should an external clock input be used, it must be exactly 10 MHz or the multipliers will not activate.

NOTE

To use the HF OUTPUTS the DEVIATION switch MUST be set to OFF or the multipliers will not function and no output signals will appear at the 5 ns and 2 ns HF OUT connectors.

4-41. To connect the HF OUTPUTS to an oscilloscope, digital counter, spectrum analyzer or sweep generator marker input, use a short 50 ohm cable terminated in BNC connectors. If the instrument under test has a 50 ohm input impedance, no further termination is required. If the input impedance is high (such as a 1 megohm oscilloscope or counter) use a 50 ohm feed thru termination at the input connector of the instrument under test. The Ballantine Model 12630A feed thru termination is recommended. It is important to present a true 50 ohm terminated system to the HF outputs. VSWR higher than 1.1 on large capacitive loads may detune the multipliers and result in loss of output amplitude and increased distortion. If a high VSWR load is unavoidable, buffer it with a coaxial attenuator of 6 db or 10 db attenuation to minimize termination difficulties.

4-42. There is no DEVIATION capability for the 2 ns and 5 ns HF outputs and the DEVIATION control MUST be set to OFF when HF outputs are to be used.

4-42. 1 ns (1 GHz) Output With Model 61251A Optional Multiplier.

4-44. The Model 61251A Frequency Doubler is an optional accessory which will double any frequency input over the range of 100 MHz to 1 GHz. It may be used to double the 100 MHz (10 ns marker) and provide 200 MHz output with full deviation capability to provide 180 to 220 MHz. The 61251A may also be used with the 5 ns HF OUT to provide 400 MHz and with the 2 ns HF OUT to provide 1 GHz signals locked to the master system clock oscillator or EXT 10 MHz clock input. No deviation capability is provided for the 2 ns and 5 ns HF outputs.

4-45. The 2.5 ns and 1 ns markers, provided by the optional 61251A Frequency Doubler, may be used to check digital frequency counters, sampling scope time calibration, markers on spectrum analyzers and sweep signal generators.

4-46. To use the 61251A Frequency Doubler simply insert it into the HF output cabling system described above and hook it into the BNC cable system at the input of the 50 ohm feed thru termination or the device under test. The 61251A is a 50 ohm input/output device and must be terminated by a low VSWR 50 ohm system.

4-47. TRIGGER OUTPUT.

4-48. The TRIG OUT connector of the 6125B/C provides a squarewave derived from the master clock of the system and with frequency independently variable of the MARKER OUT signal.

4-49. The TRIG OUT squarewave is used for checking ratio mode in digital counters and to permit check of trigger circuits in oscilloscopes. The TRIG OUT signal has a very fast rise time (< 1 ns) and is therefore rich in harmonics for checking frequency calibration of spectrum analyzers and other frequency domain devices. The fast rise time is intended for checking the vertical amplifier alignment of oscilloscopes as detailed in paragraph 4-

4-50. External Triggering of Oscilloscopes.

a. Set the scope for external triggered operation. Connect the 6125B/C TRIG OUT signal to the scope's external trig input and use a 50 ohm termination at the scope.

b. In general, the trigger period should be slower than the marker period displayed on the scope. This avoids the appearance of an unmarked base line on the scope. Keeping trigger rate high will give the brightest display on the scope.

c. Varying the trigger period while checking calibration of any one scope time base range will check scope time base calibration, jitter factor and general trigger stability when signals of varying repetition rates are displayed on the oscilloscope during its normal use.

d. As a convenience the scope being calibrated with the 6125B/C may be externally triggered at a fixed rate (i.e. 1 ms). This avoids the need to adjust scope triggering when the faster sweep speed ranges are being calibrated or checked. This is the special advantage on scopes with poor trigger performance.

4-51. The internal MARKER-TRIGGER INTERLOCK switch is used in conjunction with external trigger operation for oscilloscopes, radar sets and other applications involving exact time coincidence between the TRIG OUT and MARKER OUT signals.

a. In the NORMAL setting of the internal MARKER-TRIGGER INTERLOCK switch, the digital dividers in the trigger and marker circuits are independent ripple counters with no compensation for the few nanoseconds of accumulated delay which may be different in each divider chain. The NORMAL setting provides TRIG OUT for all settings of the TRIGGER PERIOD and TIME/DIV (and MULTIPLIER) settings.

b. Use of the NORMAL mode in externally triggered scope calibration may require reset of horizontal trace positioning when checking fast time base speed (faster than $1 \mu\text{s}/\text{DIV}$). The phasing changes of the TRIG OUT with respect to the MARKER OUT signals will require this trace realignment. As an extra convenience and speed up calibration (and programmed operation with the 6125C). The LOCKOUT mode is provided.

c. In the LOCKOUT mode a gating circuit provides exact time coincidence between the rise of the TRIG OUT and MARKER OUT signals. This time coincidence is advantageous when calibrating complex timing circuits such as radars and facilitates externally triggered sweep time calibration of oscilloscopes.

4-52. RISE TIME MEASUREMENTS.

4-53. The TRIG OUT square wave of the 6125B/C provides a clean, fast rise which is intended for use as a test signal for checking the bandwidth and high frequency alignment of wideband amplifiers such as the vertical amplifiers of oscilloscopes.

4-54. Amplitude For Rise Time Measurements.

a. It is usual to measure the rise time of an oscilloscope amplifier with the scope input attenuator set for maximum sensitivity (i.e. straight through with no attenuation).

b. The 6125B/C TRIG OUT square wave delivers 250 mV into 50 ohm or 500 mV unterminated. This is sufficient to produce 5 divisions of deflection at 50 mV or even 100 mV/DIV. Unterminated operation is not recommended for amplifiers having a bandwidth greater than 5 MHz.

c. The FAST RISE & TRIG AMPLITUDE control on the 6125B/C provides continuously variable TRIG OUT amplitude over the range of 200 mV to 250 mV when terminated in 50 ohms. This amplitude adjustment permits exact alignment of the rise time on the scope graticule for 4 and 5 divisions and avoids the necessity to use the scope variable gain control for exact trace alignment. The scope variable gain control often deteriorates the effective amplifier response and the 6125B/C AMPLITUDE control provides control without loss of fidelity.

d. For scopes and amplifiers having greater sensitivity (i.e. to 1 mV or 5 mV/DIV), an additional coaxial wideband attenuator (such as the GR874 Series) should be included in the 50 ohm transmission line from the TRIG OUT connector to the input of the amplifier. Always use a feed-thru 50 ohm termination such as the Ballantine 12630A directly at the input connector of the amplifier.

4-55. Cable Matching For Rise Time Measurements.

a. The impedance of the connecting cable and coaxial components should

be 50 ohms $\pm 2\%$. Cable length should be kept as short as possible since long cables (longer than 1 meter) will degrade the rise time of the TRIG OUT square wave.

b. The 50 ohm cable should be terminated in 50 ohms. This also presents a low source impedance to drive the input impedance of the amplifier. It may be desirable to use a two times (or greater) divider as the 50 ohm termination so that the loading of the amplifier is minimized by the lower driving impedance. Many high frequency oscilloscopes are designed to be calibrated and checked from a 25 ohm source.

c. In practice the deteriorating effect of scope amplifier input loading on the properly terminated TRIG OUT fast rise signal is of importance only for scopes having greater than 50 MHz bandwidth (< 7 nanosecond rise time).

4-56. Rise-Time Measurement Accuracy.

a. Before measuring the rise time of a scope amplifier, the time calibration of the scope time base should be checked at the speed and in the graticule area to be used for displaying the rise time signal.

-NOTE-

Always calibrate the time base of the oscilloscope in the region where rise-time checks are usually made on the fastest sweep range and the operator must correct for beginning trace non-linearity and magnifier errors which often account for 8 to 10% timing error. Risetimes should be measured some 50 or more nanoseconds from the beginning of the visible scope trace and near screen center for best results.

b. The 1 nanosecond positive going rise of the TRIG OUT square wave is adequate to check scopes bearing bandwidths to 250 MHz. The 1 nanosecond

rise will increase the rise time displayed on the scope by only 1% for 50 MHz scopes having 7 nanosecond rise time. For slower oscilloscopes the displayed rise-time may be taken as the true rise time of the scope amplifier. For faster scopes the true rise time is given by:

True Rise Time =

$$\sqrt{\text{Displayed rise time}^2 - (\text{Source Rise Time})^2}$$

4-56. Fast-Rise Measurement Procedures.

a. Connect the TRIG OUT to the amplifier's input by a short 50 ohm cable, any required coaxial attenuators and a 50 ohm termination at the input of the amplifier.

b. Select the desired TRIGGER PERIOD. Use a faster trigger rate to optimize display brightness.

c. Adjust the scope trigger circuit and Time/Div. control to display the fast rise on the CRT. Position the pulse past the first 50 nanoseconds of sweep and horizontally position it at the center of the graticule. Be sure the sweep has been accurately calibrated at this point and that the slope of the rise time extends over more than half a major graticule division.

d. Use the 6125B/C AMPLITUDE control to align the top and bottom of the rise to 0% and 100% reference line or use 5 graticule divisions. Measure the time between the 10% and 90% amplifier high frequency alignment.

4-57. Model 61252A Fast Rise Accessory.

a. The Model 61252A fast rise accessory provides a test rise time of <125 picoseconds (8 times faster than the TRIG OUT rise). This gives the 6125B/C Time and Amplitude Test Set the capability to check amplifiers and spectrum analyzers into the gigahertz bandwidth region.

b. The Model 61252A uses an ultra high speed tunnel diode to generate the rise.

c. Use the same test set-up and procedures indicated above to connect the 61252A accessory to the amplifier under test.

d. Connect the 61252A input to the VOLTS OUT connector on the 6125B/C. Apply 60 to 100 volt square wave at the highest output mode frequency that results in a stable display after adjusting the 61252A fast rise control.

Figure 4- . Rise Time Display.

4-58. Line Frequency Output.

a. The LINE FREQ output connector supplies continuously variable amplitudes from 0 to 1 volt peak to peak of power mains frequency. The power mains sinewave is filtered to reduce noise and higher frequency interference.

b. The LINE FREQ signal is useful for checking low frequency operation (period and low frequency multipliers) of digital counters and for checking sensitivity, trigger level, range and slope for counters and oscilloscopes.

CODE INSTRUCTION SET
FOR
IEEE-488-1975 EXTERNAL BUS ADAPTER
AND
BALLANTINE MODEL 6125C
TIME AND AMPLITUDE TEST SET

TIME/DIV. &
Multiplier

TRIGGER PERIOD
Remote/Local Sel

DEVIATION
D/A Select

VOLTS/DIV. &
MULTIPLIER

VOLTS OUTPUT MODE
REMOTE/LOCAL SELECT

DEVIATION
VOLTS/TIME/OFF

TABLES

ASCII CODE CHART

BITS		0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
HEX 00 01 02 03		CONTROL		NUMBERS SYMBOLS		UPPER CASE		LOWER CASE	
0 0 0 0	0	NUL	DLE	SP	0	@	P	\	p
0 0 0 1	1	SOH	DC1	!	1	A	Q	a	q
0 0 1 0	2	STX	DC2	"	2	B	R	b	r
0 0 1 1	3	ETX	DC3	#	3	C	S	c	s
0 1 0 0	4	EOT	DC4	\$	4	D	T	d	t
0 1 0 1	5	ENQ	NAK	%	5	E	U	e	u
0 1 1 0	6	ACK	SYN	&	6	F	V	f	v
0 1 1 1	7	BEL	ETB	'	7	G	W	g	w
1 0 0 0	8	BS	CAN	(	8	H	X	h	x
1 0 0 1	9	HT	EM	)	9	I	Y	i	y
1 0 1 0	10	LF	SUB	*	10	J	Z	j	z
1 0 1 1	11	VT	ESC	+	11	K	[	k	{
1 1 0 0	12	FF	FS	,	12	L	\	l	
1 1 0 1	13	CR	GS	-	13	M	]	m	}
1 1 1 0	14	SO	RS	.	14	N	^	n	~
1 1 1 1	15	SI	US	/	15	O	_	o	°
UNIVERSAL COMMAND		LISTEN ADDRESS		TALK ADDRESS		SECONDARY ADDRESSES			
		0 0 0 0		0 0 0 1		0 0 1 0		0 0 1 1	
		0 1 0 0		0 1 0 1		0 1 1 0		0 1 1 1	
		1 0 0 0		1 0 0 1		1 0 1 0		1 0 1 1	
		1 1 0 0		1 1 0 1		1 1 1 0		1 1 1 1	

ASCII CODE - TIME

RANGE	MULT	MSD	MSD-1
10NS	X1	C	O
	X2	C	N
	X5	C	M
	X10	C	L
20NS	X1	K	O
	X2	K	N
	X5	K	M
	X10	K	L
50NS	X1	G	O
	X2	G	N
	X5	G	M
	X10	G	L
.1μS	X1	A	O
	X2	A	N
	X5	A	M
	X10	A	L
.2μS	X1	I	O
	X2	I	N
	X5	I	M
	X10	I	L

RANGE	MULT	MSD	MSD-1
.5 μ S	X1	E	O
	X2	E	N
	X5	E	M
	X10	E	L
1 μ S	X1	@	G
	X2	@	F
	X5	@	E
	X10	@	D
2 μ S	X1	H	G
	X2	H	F
	X5	H	E
	X10	H	D
5 μ S	X1	D	G
	X2	D	F
	X5	D	E
	X10	D	D
10 μ S	X1	@	C
	X2	@	B
	X5	@	A
	X10	@	@

RANGE	MULT	MSD	MSD-1
20 μ S	X1	H	C
	X2	H	B
	X5	H	A
	X10	H	@
50 μ S	X1	D	C
	X2	D	B
	X5	D	A
	X10	D	@
.1MS	X1	B	C
	X2	B	B
	X5	B	A
	X10	B	@
.2MS	X1	J	C
	X2	J	B
	X5	J	A
	X10	J	@
.5MS	X1	F	C
	X2	F	B
	X5	F	A
	X10	F	@

RANGE	MULT	MSD	MSD-1
1MS	X1	A	C
	X2	A	B
	X5	A	A
	X10	A	@
2MS	X1	I	C
	X2	I	B
	X5	I	A
	X10	I	@
5MS	X1	E	C
	X2	E	B
	X5	E	A
	X10	E	@
10MS	X1	C	C
	X2	C	B
	X5	C	A
	X10	C	@
20MS	X1	K	C
	X2	K	B
	X5	K	A
	X10	K	@

RANGE	MULT	MSD	MSD-1
50MS	X1	G	C
	X2	G	B
	X5	G	A
	X10	G	@
.1sec	X1	@	K
	X2	@	J
	X5	@	I
	X10	@	H
.2sec	X1	H	K
	X2	H	J
	X5	H	I
	X10	H	H
.5sec	X1	D	K
	X2	D	J
	X5	D	I
	X10	D	H

RANGE	MULT	MSD	MSD-1
1 Sec	X1	B	K
	X2	B	J
	X5	B	I
	X10	B	H
2 Sec	X1	J	K
	X2	J	J
	X5	J	I
	X10	J	H
5 Sec	X1	F	K
	X2	F	J
	X5	F	I
	X10	F	H

TRIGGER PER.	SELECT REMOTE	MSD-2
100NS	Local Remote	N O
1 μ S	Local Remote	@ A
10 μ S	Local Remote	H I
100 μ S	Local Remote	D E
1MS	Local Remote	L M
10MS	Local Remote	B C
100MS	Local Remote	J K
1 Sec	Local Remote	F G

ASCII CODE - AMPLITUDE

Volts/Div.	MULT	MSD-5	MSD-6
10 μ V	X1	@	@
	X2	@	D
	X3	@	B
	X4	@	F
	X5	@	A
	X6	@	E
	X8	@	C
	X10	@	G
20 μ V	X1	H	@
	X2	H	D
	X3	H	B
	X4	H	F
	X5	H	A
	X6	H	E
	X8	H	C
	X10	H	G
50 μ V	X1	D	@
	X2	D	D
	X3	D	B
	X4	D	F
	X5	D	A
	X6	D	E
	X8	D	C
	X10	D	G

VOLTS/DIV	MULT	MSD-5	MSD-6
.1mV	X1	B	@
	X2	B	D
	X3	B	B
	X4	B	F
	X5	B	A
	X6	B	E
	X8	B	C
	X10	B	G
.2mV	X1	J	@
	X2	J	D
	X3	J	B
	X4	J	F
	X5	J	A
	X6	J	E
	X8	J	C
	X10	J	G
.5mV	X1	F	@
	X2	F	D
	X3	F	B
	X4	F	F
	X5	F	A
	X6	F	E
	X8	F	C
	X10	F	G

VOLTS/DIV	MULT	MSD-5	MSD-6
1mV	X1	A	@
	X2	A	D
	X3	A	B
	X4	A	F
	X5	A	A
	X6	A	E
	X8	A	C
	X10	A	G
2mV	X1	I	@
	X2	I	D
	X3	I	B
	X4	I	F
	X5	I	A
	X6	I	E
	X8	I	C
	X10	I	G
5mV	X1	E	@
	X2	E	D
	X3	E	B
	X4	E	F
	X5	E	A
	X6	E	E
	X8	E	C
	X10	E	G

VOLTS/DIV	MULT	MSD-5	MSD-6
10mV	X1	C	@
	X2	C	D
	X3	C	B
	X4	C	F
	X5	C	A
	X6	C	E
	X8	C	C
	X10	C	G
20mV	X1	K	@
	X2	K	D
	X3	K	B
	X4	K	F
	X5	K	A
	X6	K	E
	X8	K	C
	X10	K	G
50mV	X1	D	H
	X2	D	L
	X3	D	J
	X4	D	N
	X5	D	I
	X6	D	M
	X8	D	K
	X10	D	O

VOLTS / DIV.	MULT	MSD-5	MSD-6
.1V	X1	B	H
	X2	B	L
	X3	B	J
	X4	B	N
	X5	B	I
	X6	B	M
	X8	B	K
	X10	B	O
.2V	X1	J	H
	X2	J	L
	X3	J	J
	X4	J	N
	X5	J	I
	X6	J	M
	X8	J	K
	X10	J	O
.5V	X1	F	H
	X2	F	L
	X3	F	J
	X4	F	N
	X5	F	I
	X6	F	M
	X8	F	K
	X10	F	O

VOLTS/ DIV.	MULT	MSD-5	MSD-6
1V	X1	A	H
	X2	A	L
	X3	A	J
	X4	A	N
	X5	A	I
	X6	A	M
	X8	A	K
	X10	A	O
2V	X1	I	H
	X2	I	L
	X3	I	J
	X4	I	N
	X5	I	I
	X6	I	M
	X8	I	K
	X10	I	O
5V	X1	E	H
	X2	E	L
	X3	E	J
	X4	E	N
	X5	E	I
	X6	E	M
	X8	E	K
	X10	E	O



VOLTS/DIV.	MULT	MSD-5	MSD-6
10	X1	C	H
	X2	C	L
	X3	C	J
	X4	C	N
	X5	C	I
	X6	C	M
	X8	C	K
	X10	C	O
20	X1	K	H
	X2	K	L
	X3	K	J
	X4	K	N
	X5	K	I
	X6	K	M
	X8	K	K
	X10	K	O

ASCII CODE - AMPLITUDE

MODE	REMOTE	MSD-7
	LOCAL	
-	local	F
	Remote	G
GND	local	@
	Remote	A
+	local	N
	Remote	O
10KHz	local	D
	Remote	E
1KHz	local	L
	Remote	M
100Hz	local	B
	Remote	C
10Hz	local	J
	Remote	K

ASCII CODES AMPLITUDE & TIME

DEVIATION

MSD-4

MSD-3

@
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O

@
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O

DEVIATION SELECT

MSD-8

Time
off
Amp

H
@
D

CABLE RUN EXTERNAL IEEE BUS ADAPTER

TO

MODEL 6125C PROGRAM CONNECTORS

TIME CONNECTOR

DEVICE SIGNAL		OUTPUT SIGNAL	OUTPUT PIN NO.	6125C PIN NO.
GND				7
Time/Div	MSD	1	13	19
		2	14	18
		4	15	23
		8	16	24
	MSD-1	1	11	22
		2	10	21
MULT		4	9	17
		8	8	16
TRIGGER PERIOD	MSD-2	1	2	9
		2	3	11
		4	4	12
REMOTE SELECT		8	6	20
DEVIATION SIGNAL	MSD-3	1	38	5
		2	39	4
		4	40	3
		8	7	2
	MSD-4	1	29	15
		2	26	13
		4	27	14
		8	28	1
DEVIATION SWITCH	MSD-8	1	34	10 Time
		2	35	13 Volts
		4	37	-
		8	36	-

AMPLITUDE CONNECTOR

DEVICE SIGNAL	OUTPUT SIGNAL	OUTPUT PIN NO.	6125C PIN NO.
Volts/Div. Range	MSD-5	1	47
		2	46
		4	45
		8	44
	MSD-6	1	20
MULT		2	19
		4	18
		8	17
MODE	MSD-7	1	12
		2	43
		4	42
REMOTE SELECT		8	41
DEVIATION SIGNAL	MSD-3	1	38
		2	39
		4	40
		8	7
	MSD-4	1	29
		2	26
		4	27
		8	28

SECTION V

CALIBRATION AND MAINTENANCE INSTRUCTIONS

5-1. INTRODUCTION.

5-2. This section contains information required for maintenance of the 6125B/C Time and Amplitude Test Set, including performance checks, preventive maintenance, troubleshooting, adjustment, and calibration procedures.

5-3. The generator uses premium components and with proper usage and maintenance will provide many years of satisfactory service. The manufacturer recommends that if the instrument is used for routine laboratory service, performance checks and preventive maintenance be performed every six months.

5-4. TEST EQUIPMENT.

5-5. The test equipment required to check, calibrate, and maintain the generator is listed in Table 5-1. Equivalent test equipment may be substituted if the recommended items are not available.

5-6. PERFORMANCE CHECKS.

5-7. GENERAL. The performance checks described in the following paragraphs are "in-cabinet" tests that compare the generator with the applicable specifications. A suggested test record form, shown in Figure 5-6, may be duplicated and used to record the results. These performance checks, paragraphs 5-8 through 5-18, should be performed and completed in the order listed before any attempt is made to calibrate the instrument. For optimum performance, after turn-on but before performing any check tests, allow the instrument to warm up for at least 2 hours. Also, all performance checks and calibrations should be performed at reference conditions of 22°C to 28°C (71.6°F to 82.4°F).

5.8. POWER LINE VOLTAGE SETTING. The primary winding of the transformer in the generator is connected to match the power line voltage being used by the orientation of the printed-circuit board in the rear panel mounted ac power receptacle. The instrument as supplied is set for operation from 120 volts ac. The performance checks which follow reference 120 volts as the nominal voltage setting for the 120 volt primary power line voltage. For the other power line voltages of 100, 220, and 240 volts ac, the following table lists the nominal midline voltages and the high-line and low-line voltages used for calibrating the instrument.

<u>Line Voltage</u>	<u>Nominal Midline</u>	<u>Low Line</u>	<u>High Line</u>
100 V	100 V	90 V	108 V
120 V	120 V	103 V	130 V
220 V	220 V	198 V	238 V
240 V	240 V	216 V	256 V

5-9. OSCILLATOR FREQUENCY ACCURACY

a. Interconnect the generator and the test equipment as shown in Figure 5-2.

b. Set the generator TIME/DIV switch to .1 μS and the MULTIPLIER switch to X1.

c. Connect the MARKER OUTPUT connector to the A input of the 5548A (Option 14) Frequency Counter. Use a 50-ohm feed-through termination at the counter end of the connecting cable.

d. Set line voltage Variac to midline

e. If available, use a 1 MHz atomic frequency standard or a WWV receiver to clock the 5548A to ensure absolute accuracy of the frequency measurement.

f. Allow 20 minutes for warm-up, then measure the 0.1- μs time (10 MHz frequency). Use the SENSITIVITY control on the 5548A to obtain a stable count. To meet specification, the counter must read within the range of 9,999,919 to 10,000,081 Hz. If desired, allow the equipment to warm up 2 hours and repeat the frequency measurement. The counter should read within the range of 9,999,939 to 10,000,061 Hz.

Table 5-1. Test Equipment

EQUIPMENT NO.	NOMENCLATURE	USE AND APPLICATION	MINIMUM SPECIFICATIONS
Ballantine Model 066B)	Oscilloscope	General fault finding.	5 mV, dual trace, 8 x 10 cm graticule. DC to 15 MHz; rise time < 17 ns. Signal delay. Sweep time < 50 ns/cm to > 1 s/cm.
Ballantine Model 028B	Multimeter	Fault finding; power supply supply and resistance checks.	DC, 1 mV to 1 kV. AC, 1 mV to 500 V, 10 - Hz to 100 kHz rms responding. Ohms, 0.1 Ω to 20 M Ω , 0.2 V to 2 V measuring voltage. AC amperes, 100 mA to 1A. DC amperes, 100 mA to 1A. 3-1/2 digit display, bat- tery and line operation.
Ballantine Model 3620A	AC/DC True RMS Digital Voltmeter	Line voltage measurement.	4-1/2 digit display. 10 mV to 1 kV full scale. 1 μ V resolution. DC and ac to 1 MHz, dc coupled true rms response. Nominal accuracy 0.2%. Guarded and floating input.
Ballantine Model 5548A (with Option 14)	Digital Frequency Counter	Frequency calibration and check of frequency multi- pliers 500 MHz (2 ns). Check of TIME DEVIATION range.	512-MHz nine-digit counter with high- stability clock (3 parts in 10^9 per day) and NBS frequency traceability. External clock input capability. Sensitivity better than 15 mV rms at 500 MHz. PERIOD MEASUREMENT.
Fluke Model 55AB	Differential Voltmeter	DC Voltage Calibration	DC; 1 volt to 300 volts with 10 μ V resolution. Accuracy 0.02%
1 Megohm Resistor	RN65D	Volts Out Termination	1/2 watt $\pm$ 2%, film.
2 Megohm	RN70D	Square Wave Level check.	1/2 watt $\pm$ 2%, film.

Table 5-1. Test Equipment (Cont)

EQUIPMENT NO.	NOMENCLATURE	USE AND APPLICATION	MINIMUM SPECIFICATIONS
allantine Model 12620A	Adapter	Test equipment connections.	BNC female to General Radio GR-874 connector.
allantine Model 12625A	Adapter	Test equipment connections.	BNC male to General Radio GR-874 connector.
allantine Model 12630A	Termination	Termination, .50 ohms, 2 watts.	BNC/BNC feedthrough, 50 ohms, 2 watts.
allantine Model 12249A	Cable Assembly, 8 in.	Test equipment connections.	RG-58C/U cable with male BNC terminations.
allantine Model 12249D	Cable Assembly, 48 in.	Test equipment connections.	RG-58C/U cable with male BNC terminations.
General Radio Type GR-874 allantine Model 12626A)	Attenuator, 20 dB	Input attenuator for high-sensitivity sampling oscilloscope.	50-ohm, 20-dB attenuator, dc to 1 GHz, flatness 0.1%, dc to 100 MHz.
General Radio Type W5MT3A	Metered Variac	Line voltage control; metered current and voltage.	(As required.)
ewlett-Packard Model 651B or 652A	Test Oscillator	Test external clock input signal source.	10 Hz to 10 MHz (sine wave). 50-ohm output to 2 V rms. Distortion < $\pm 0.25\%$.
FD Part No. 5284	Adjustment Tool	Adjustment of variable capacitors, resistors, and inductors.	Low-capacity alignment tool with 3/32 inch screwdriver blade and 5/64 hexagon drive.
hde & Schwarz Model XSAM or Model XSA/XKA*	Frequency Standard, Atomic or WWV Receiver	To calibrate clock frequency.	Rubidium frequency standard, 1 MHz, or WWV receiver/comparator, 1 MHz.
lektronix Type 547 with 1S1 plug-in)	Oscilloscope	Check fast rise time (≤ 3 ns) of TRIGGER output square wave.	Frequency response to 1 GHz. Rise time < 0.35 ns. Internal and external triggering beyond 500 MHz. 50-ohm input. Sensitivity better than 50 mV/cm. Sweep time < 2 ns/cm to 0.1 us/cm.
G-274A/U allantine Model 12619A)	Adapter	Test equipment connections.	BNC tee adapter.

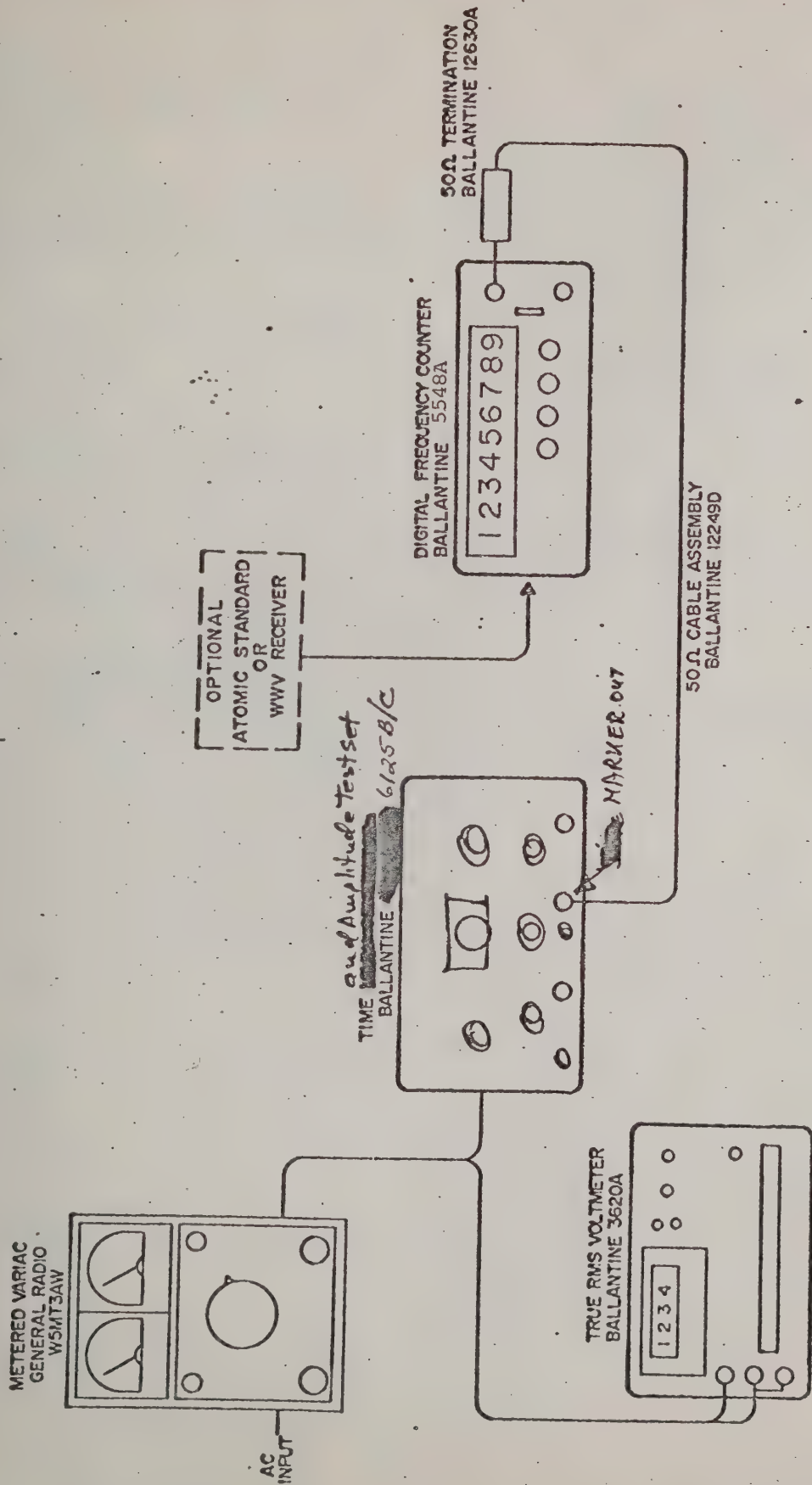


Figure 5-2. Clock Frequency Check. Bench Test Setup.

g. With line voltage set to 103 volts by the Variac, the counter should read within the range of 9,999,899 to 10,000,101 Hz.

h. Within line voltage set to 128-volts by the Variac, the counter should read within the range of 9,999,899 to 10,000,101 Hz.

i. Reset the line voltage to midline.

5-10. MARKER OUTPUT.

a. Interconnect the generator and the test equipment as shown in Figure 5-3.

b. Connect the MARKET OUTPUT connector to the CH1 input connector of the Ballantine 1066B Oscilloscope. Connect a 50-ohm feed-through termination at the oscilloscope end of the connecting cable.

c. Set the TIME/DIV switch to .1 μ S and the MULTIPLIER switch to X1.

d. Set the 1066B Oscilloscope controls as follows:

CH1 VOLTS/CM	.5 V
CH1 Coupling	DC
CH1 Position	Centered
CH2 Position	OFF
TIME/CM	1 μ S
PULL x 10 MAG	Pulled Out (X10)
TRIG SELECT	CH1 +
Trigger Coupling	AC

e. Use trigger LEVEL control and trace-position controls to position a stable display on screen.

f. Observe a marker pulse on the oscilloscope at each vertical line of the CRT graticule. Continue to observe the same display but with somewhat narrower

positive-going marker pulses at each TIME/DIV and oscilloscope sweep range through 0.5 second. Do not use X10 magnifier on the oscilloscope at time-base speeds slower than 0.5 μ s. Observe that the minimum marker pulse amplitude displayed on the oscilloscope is greater than 1 cm (0.5 volt) for each of the 27 MARKER OUTPUT settings.

g. Set the MULTIPLIER control to X2 and the oscilloscope TIME/DIV switch at 5 SEC. Observe six pulses with one pulse coincident with alternate graticule lines, which checks the MULTIPLIER X2.

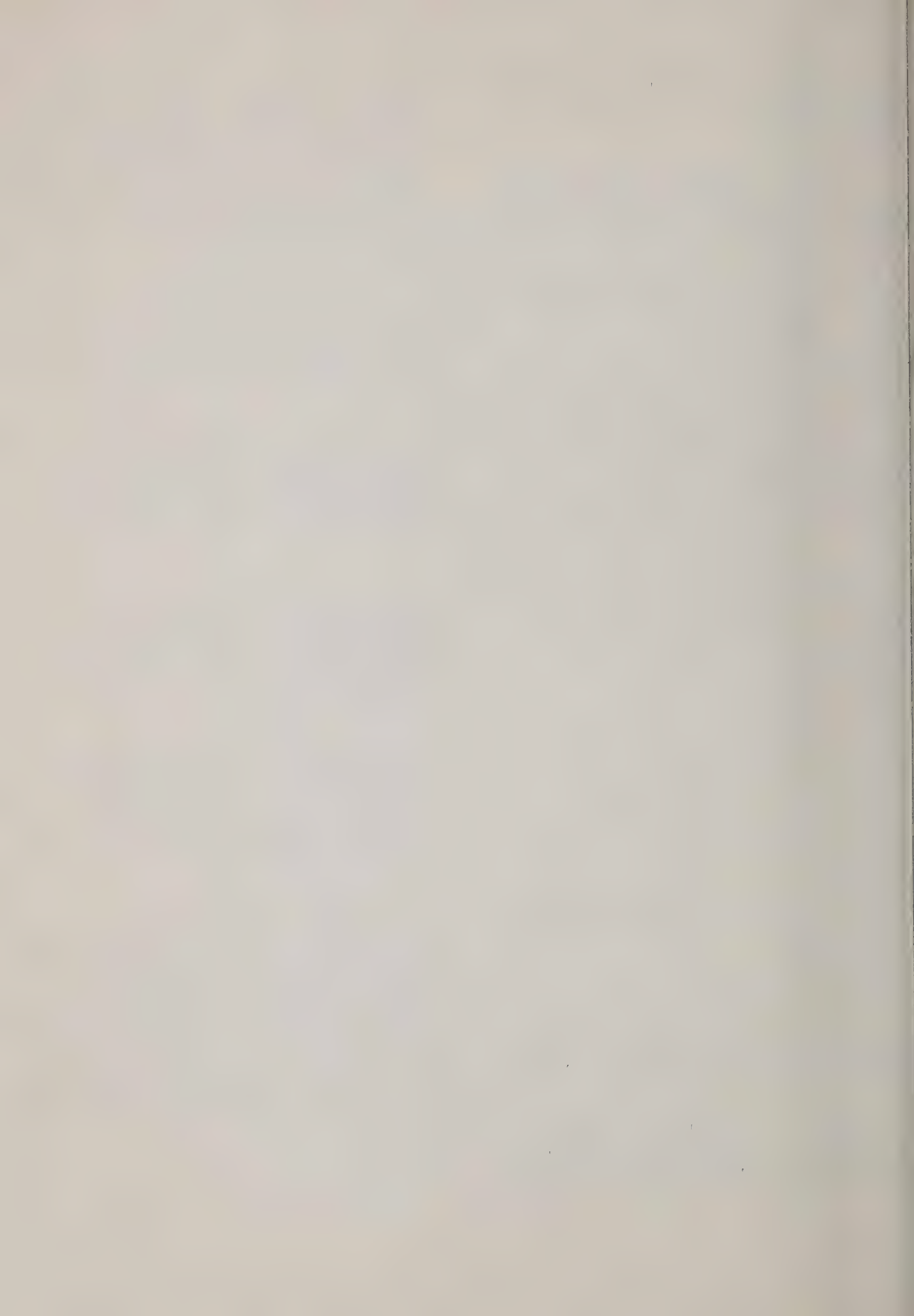
h. Set the MULTIPLIER control to X5. Observe three marker pulses on the screen, one at the left, one at the center, and one at the right graticule line, which checks the MULTIPLIER X5.

i. Set the MULTIPLIER control to X10. Observe two markers on the screen, one at the extreme left and one at the extreme right graticule line, which checks the 5-second marker and the MULTIPLIER X10.

j. With the MULTIPLIER control still set to X10, set the TIME/DIV switch to .2 S and the oscilloscope TIME/CM control to .2 Sec. Observe that only two pulses appear on the screen, which checks the MULTIPLIER X10.

5-11. TRIGGER PERIOD.

a. Continue with the control settings of paragraph 5-10 and the test setup of Figure 5-3, except disconnect the cable from the MARKER OUTPUT connector and reconnect it to the TRIGGER OUT connector. Also, set the Trigger PERIOD to 100 nS and the oscilloscope TIME/CM switch to 1 μ s, and activate the X10 MAG knob for X10 magnifier position for a sweep of 0.1 μ s/cm.



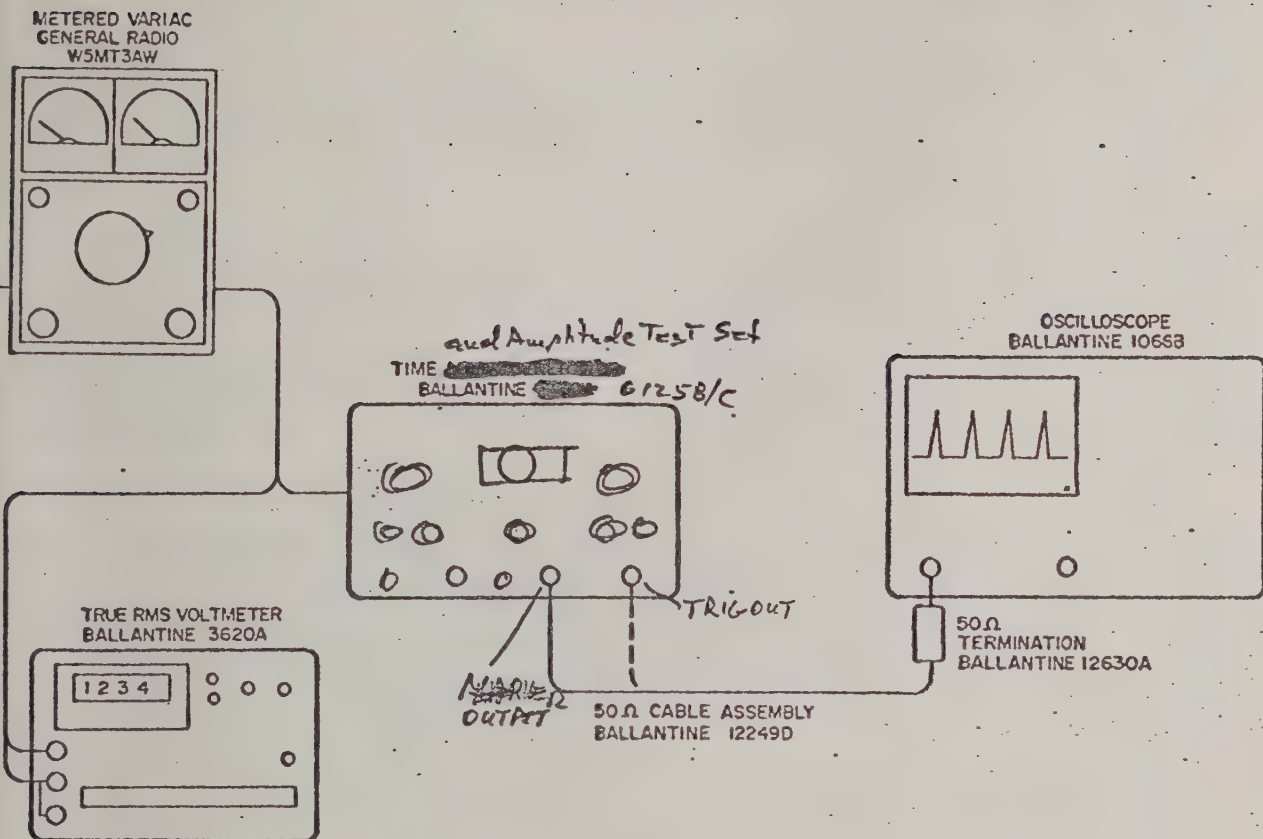


Figure 5-3. Trigger and Marker Amplitude Check, Bench Test Setup

b. Observe a square wave display on the oscilloscope screen. Its amplitude must be greater than 1 cm and the period of each full square wave must occupy 1 cm.

c. Change the TRIGGER PERIOD to 1 μ S and reset the oscilloscope X10 MAG knob to the X1 position (sweep of 1 μ S per cm). Observe a square wave as in the preceding step b.

d. In sequence, change the TRIGGER PERIOD and the oscilloscope TIME/CM settings to 10 μ S, 100 μ S (.1 mS), 1 mS, 10 mS, 100 mS (.1 SEC), and 1 S (1 SEC). Observe the same 1 cm square wave as in the preceding step b on each of the paired settings.

5-12. TRIGGER OUTPUT RISE TIME.

a. Interconnect the generator and the test equipment as shown in Figure 5-4.

b. Connect the TRIGGER OUT connector of the instrument to the sampling oscilloscope through a short (8-inch) 50-ohm cable. Use a BNC to GR adapter to connect the cable to the 50-ohm cable BNC connector. Set the oscilloscope to 100 mV vertical sensitivity, internal trigger, and 1 ns per cm sweep speed.

c. Set the TRIGGER PERIOD to 100 ns.

d. Obtain a stable display of a positive-going edge of the square wave on the screen of the oscilloscope.

e. Observe that the leading edge of the waveform on display is at least 2.5 cm peak-to-peak. This amplitude verifies a trigger-out signal greater than 0.25 volts.

f. Observe that the overshoot on the top of the leading edge is no greater than 2% of the 0% to 100% peak-to-peak value of the TRIGGER OUT square wave.

g. Observe that the 10% to 90% rise-time of the positive-going rise is no more than 1 ns (1 cm).

5-13. HIGH FREQUENCY OUTPUT.

a. Continue with the test setup shown in Figure 5-4. Disconnect the cable from the TRIGGER OUT connector and reconnect it to the H.F. OUT 5 ns connector. Set the sampling oscilloscope time base to 5 ns per cm. Obtain a stable sine-wave display on the oscilloscope.

b. Observe a sine wave greater than 2.5 cm peak-to-peak, which indicates that the H.F. OUT signal is greater than 0.5 volt peak-to-peak into 50 ohms, since the oscilloscope sensitivity is 20 mV X10 or 200 mV per cm. Also, note that the cycle-to-cycle amplitude does not vary by more than 5% peak-to-peak.

c. Observe a sine wave for each graticule line to indicate that the H.F. OUT frequency is 5 ns. Then, disconnect the short BNC cable of the BNC to GR adapter and connect it into the 50-ohm (B) input of the 500 MHz frequency counter. Set the counter to 1 second for a nine-digit display. Observe that the counter reads in the range of 200,001,601 to 199,998,399 Hz. Reconnect the BNC cable to the oscilloscope.

d. In sequence, select the HF OUT 2 ns BNC and set the sampling oscilloscope time base to 2 ns. Repeat the observations of amplitude as in the preceding step b. Repeat the sine-wave period check of 1 cycle/cm as in the preceding step c. For each HIGH FREQUENCY selection also make the digital counter frequency check detailed in preceding step c. Use the following limits:

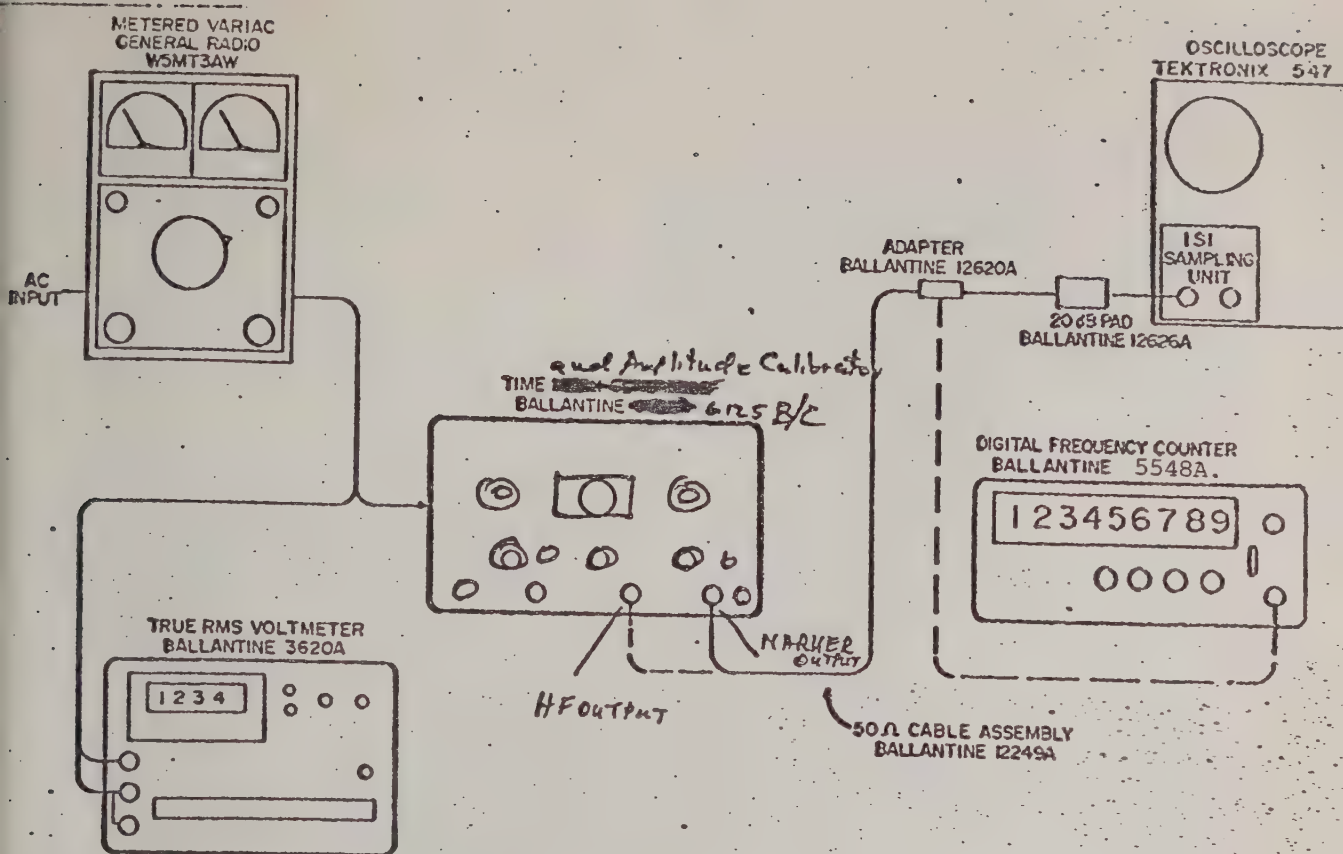


Figure 5-4. Trigger Rise Time and H.F. OUT Check, Bench Test Setup

- 5 nS: 199,998,399 through
200,001,601 Hz
- 2 nS: 499,995,999 through
500,004,001 Hz

5-14. EXTERNAL CLOCK INPUT.

- a. Interconnect the generator and the test equipment as shown in Figure 5-4.
- b. Set the TIME/DIV switch to 1 μ S and the MULTIPLIER to X1. Set the rear-panel INT-EXT clock switch to the EXT position. (These control positions check the shaper and digital-logic trigger circuitry for external clock input verification.)

- c. Set the dual-trace oscilloscope controls as follows:

CH1 VOLT/CM	.5 V
CH1 Coupling	AC
CH1 Position	Centered
CH2 Position	OFF
TIME/CM	1 mS
TRIG SELECT	FREE RUN

The oscilloscope should display a free-running, unsynchronized display of CH1 only.

- d. Set the 500 MHz frequency counter to 1 second and a nine-digit display. Connect a 50-ohm feed-through termination to the high-impedance (A) input.
- e. Connect the MARKER OUTPUT through the 50-ohm termination to the high-impedance, low-frequency input of the 100 MHz counter. Connect a BNC Tee-connector to the CH1 input of the 1066B oscilloscope and connect the 50-ohm output of the 10-MHz oscillator and the EXT clock input (INT-EXT clock switch set to EXT) to the Tee-connector arms.

- f. Adjust the oscillator amplitude to produce a 4 cm peak-to-peak vertical display on the oscilloscope. Set the frequency of the oscillator to 10 MHz maintaining the oscilloscope display of a constant 4 cm (2 volts) peak-to-peak amplitude. Note the counter which should display a frequency of 1 MHz. This checks the external clock input of the 6125B/C.

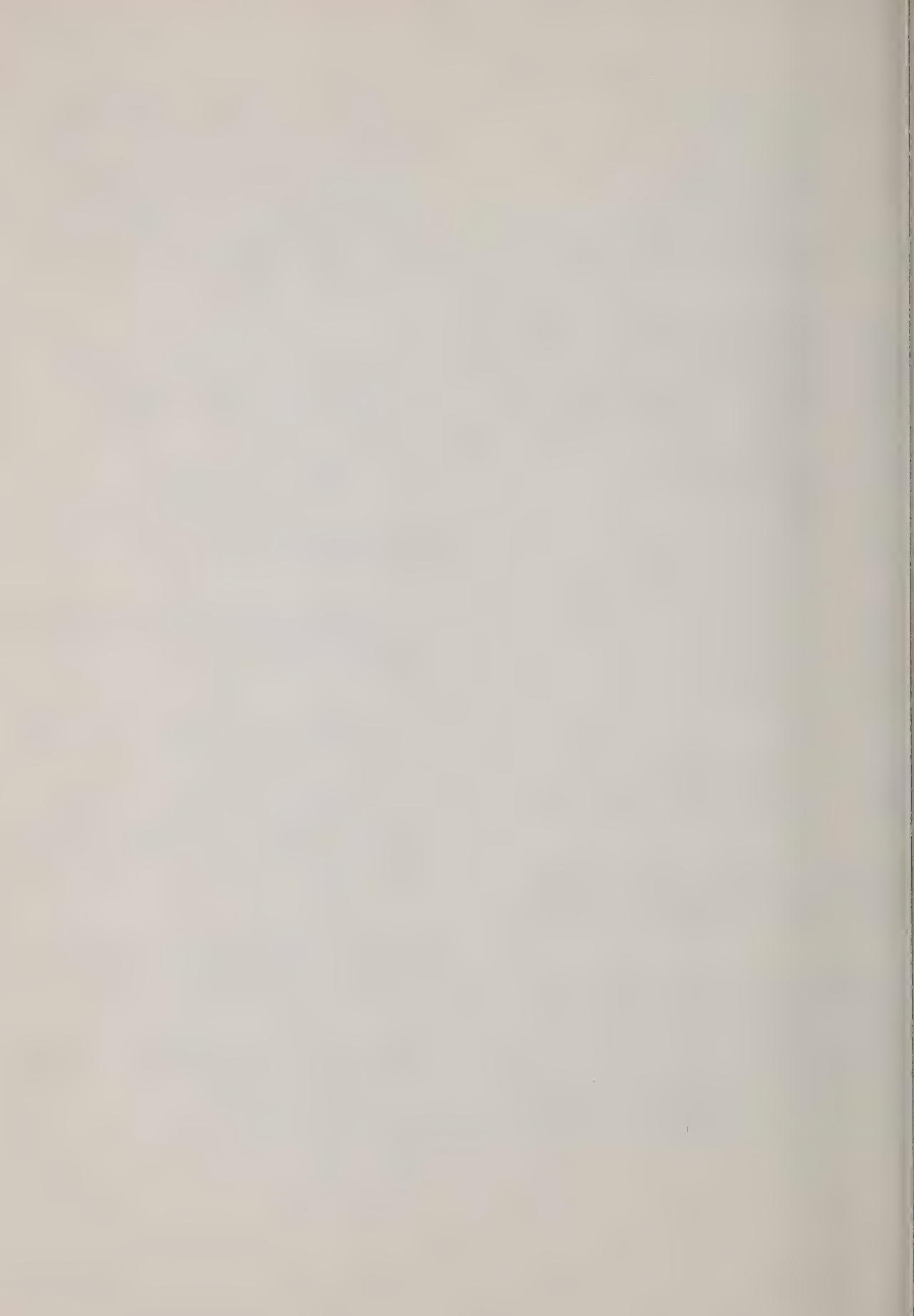
NOTE

Use only a 10 MHz EXT Input Frequency. All other frequencies will cause incorrect outputs from the 6125B/C.

5-15. TIME DEVIATION CHECK.

- a. Set the instrument to DEVIATION OFF. Set the TIME/DIV control to 10 μ S and the MULTIPLIER to X1.
- b. Connect a frequency counter to the MARKER OUT BNC as shown in Figure 5-2. Observe a frequency of 100,000 Hz (+50Hz) displayed on the counter.
- c. Set the DEVIATION switch to TIME +10%. Observe that the time DEVIATION indicator is illuminated.
- d. Rotate the TIME/DIV deviation control to each extreme and observe that the 6125 digital deviation meter displays a deviation range greater than +10% and greater than -10%.
- e. Set the time deviation to +10%. Set the frequency counter to PERIOD AVERAGE and observe that the frequency counter reads 11.000 (+ .003) μ s.
- f. Set the time deviation to -10% and observe that the frequency counter reads 9.000 (+ .003) μ s.

5-16. VOLT/DIV CHECK



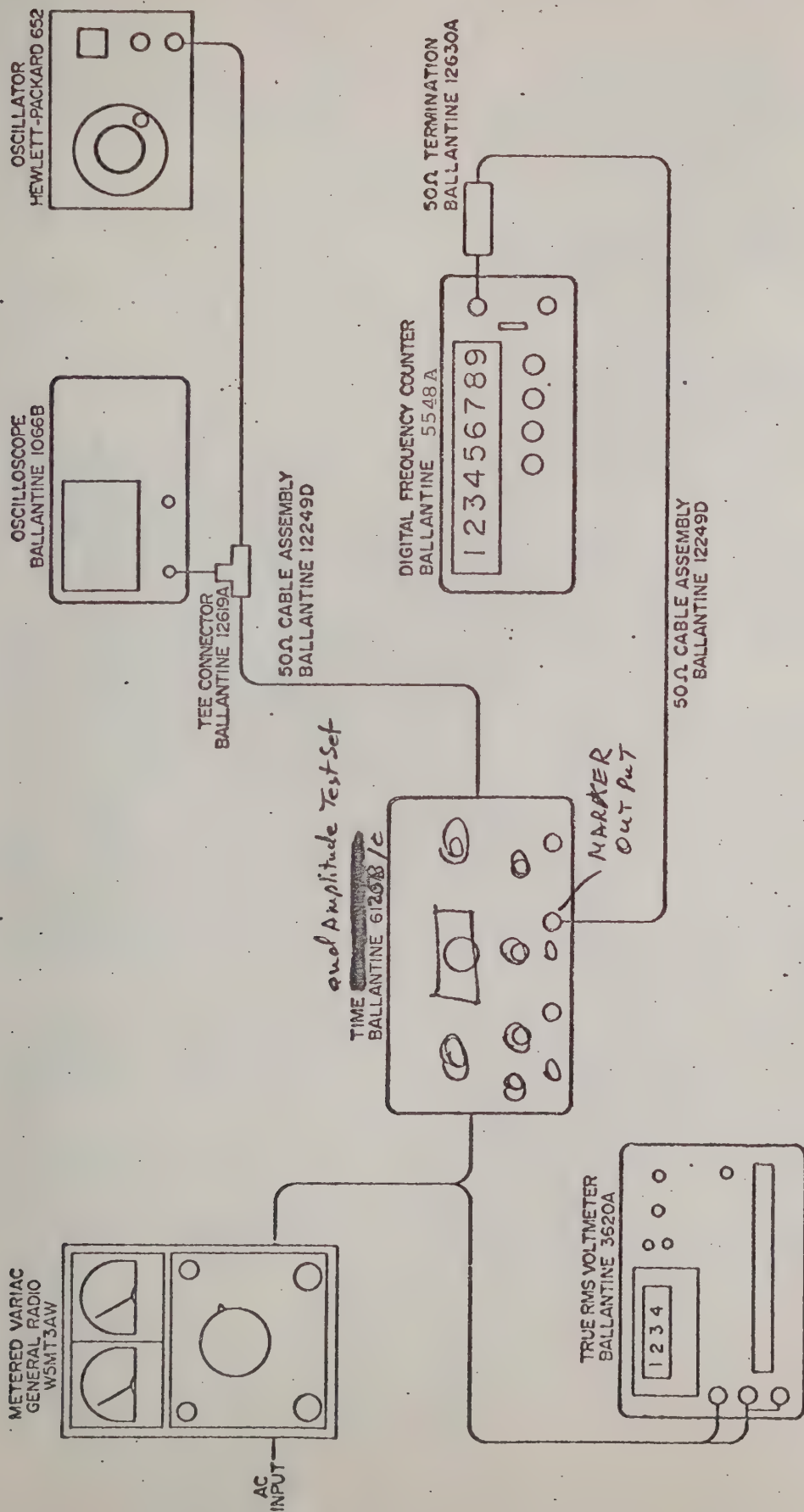


Figure 5-5. External Clock Input Check, Bench Test Setup

a. Connect a high resolution battery operated DC differential voltmeter having 1 megohm input impedance at balance to the VOLTS OUT BNC connector. Be sure of the 1 megohm load resistance since the instrument is calibrated into this typical oscilloscope or voltmeter input resistance.

b. Set the 6125 controls as follows:

VOLTS/DIV	20
MULTIPLIER	X10
OUTPUT MODE	+DC
DEVIATION	OFF

c. Set the differential voltmeter dials to 200.00 volts and read the percent deviation on the voltmeter readout. The error should be equal to or less than ± 50 mV.

d. Repeat step c for each of the next 13 ranges through the mV range and record data and calibration error on the test record form shown in Figure . These checks for ranges of 0.1 V and below are optional. Check voltmeter error to the $\pm 0.25\%$ error budget of the 6125B/C.

NOTE

Always measure the DC offset voltage by using the GND Mode. Arithmetically add this thermal voltage to all readings under ± 10 mV to obtain the exact output calibration voltage.

If errors exist for any reading, the instrument should be recalibrated as detailed in other paragraphs of this section.

Set the VOLTS/DC switch to 1 volt and the multiplier to X1, X2, X3, X4, X6, and X8. Set the differential voltmeter to 1, 2, 3, 4, 5, 6 and 10 volts respectively and make the required calibration checks.

7. VOLTS DEVIATION CHECK.

a. Leave the differential voltmeter connected as indicated above.

b. Set the VOLTS/DIV switch to 1 volt and the MULTIPLIER to X10. Set the DEVIATION to volts $\pm 10\%$ and observe that the VOLTS DEVIATION lamp is illuminated.

c. Rotate the VOLTS/DIV DEVIATION control to both ends and observe that the digital deviation meter reads greater than $\pm 10\%$.

d. Set the VOLTS/DIV DEVIATION control for a digital meter reading $\pm 10.00\%$. Set the differential voltmeter dials to 11.000 volts. Note that the differential meter reads an error equal to or less than 330 mV.

e. Set the VOLTS/DIV DEVIATION control for a digital meter reading of -10.00% . Set the differential voltmeter dials to 9.000 volts. Note that the differential voltmeter reads an error equal to or less than ± 270 mV.

5-18. VOLTS OUTPUT MODE CHECK.

a. Repeat steps 5-16b and 5-16c with the output mode set to -DC. Check proper output and disconnect the differential voltmeter.

b. Connect an oscilloscope to the VOLTS OUT BNC. Set the scope CH1 input to DC, 1 VOLT/DIV and the time base to 50 μ s with Auto Triggering.

c. Set the 6125 VOLTS/DIV SWITCH to 1 volt, the MULTIPLIER to X6 and the DEVIATION to OFF. Set the OUTPUT MODE to 100 kHz. Observe five cycles of 6 division p-p square wave displayed across the graticule of the CRT.

d. Repeat step b with OUTPUT MODE set to 1 kHz, 100 Hz and 10 Hz

PERFORMANCE ASSURANCE TEST RECORD
BALLANTINE MODEL 6125B/C

on No. _____

Date _____

l No. _____

Performed By _____

All tests shall be performed at reference conditions of 22° C to 28° C.

OSCILLATOR FREQUENCY ACCURACY (Paragraph 5-9).

Nominal Power Line Frequency Check _____

MHz

Low Line Voltage Check _____

MHz

High Line Voltage Check _____

MHz

MARKER OUTPUT (Paragraph 5-10)

6125B/C		Oscilloscope TIME/DIV	Markers Per Line	Amplitude >1 Div
TIME DIV	MULTIPLIER			
0.1 us	X1	1 us X10 (.1 us)		
0.2 us	X1	2 us X10 (.2 us)		
0.5 us	X1	5 us		
1 us	X1	1 us		
2 us	X1	2 us		
5 us	X1	5 us		
10 us	X1	10 us		
20 us	X1	20 us		
50 us	X1	50 us		
.1 ms	X1	1 ms		
.2 ms	X1	2 ms		
.5 ms	X1	5 ms		
1 ms	X1	1 ms		
2 ms	X1	2 ms		
5 ms	X1	5 ms		
10 ms	X1	10 ms		
20 ms	X1	20 ms		
50 ms	X1	50 ms		
.1 s	X1	1 s		
.2 s	X1	2 s		
.5 s	X1	5 s		
.5 s	X2	5 s		
.5 s	X5	5 s		
.5 s	X10	5 s		
.2 s	X10	2 s		

TRIGGER PERIOD (Paragraph 5-11).

6125B/C TRIGGER PERIOD	Oscilloscope TIME/DIV	Square Waves per cm	Amplitude >1 cm
100 ns	1 us X10 (.1 us)		
1 us	1 us		
10 us	10 us		
100 us	100 us		
1 ms	1 ms		
10 ms	10 ms		
100 ms	100 ms		
1 s	1 s		

4. TRIGGER OUTPUT RISE TIME (Paragraph 5-12)

Amplitude $> .25$ volt _____ volts
 Overshoot $< 2\%$ _____ volts
 Rise Time < 1 ns, 10 to 90% _____ volts

5. HIGH FREQUENCY OUTPUT (Paragraph 5-13)

5 ns Amplitude $(> 0.5$ volt) _____ volts
 5 ns Frequency (200 MHz $\pm$ 1600 Hz) _____ MHz
 2 ns Amplitude $(> 0.5$ volt) _____ volts
 2 ns Frequency (500 MHz $\pm$ 4000 Hz) _____ MHz

6. EXTERNAL CLOCK INPUT (Paragraph 5-14)

10 MHz to 100 kHz at 2 V p-p drive _____ (✓)

7. TIME DEVIATION CHECK ($> +10\%$) _____ (✓) (Paragraph 5-15) ($> -10\%$) _____ (✓)

8. VOLTS OUTPUT (Paragraph 5-16) (GND MODE DC +DC Mode Offset voltage _____ μ V)

6125B/C		VOLTMETER	
VOLTS/DIV.	MULTIPLIER	ERROR LIMITS	ERROR READING
20 V	X10	± 450 mV	
10 V	X10	± 250 mV	
5 V	X10	± 125 mV	
2 V	X10	± 50 mV	
1 V	X10	± 25 mV	
.5 V	X10	± 12.5 mV	
.2 V	X10	± 5 mV	
.1 V	X10	± 2.5 mV	
50 mV	X10	± 1.25 mV	
20 mV	X10	± 500 μ V	
10 mV	X10	± 250 μ V *	
5 mV	X10	± 125 μ V *	
2 mV	X10	± 50 μ V *	
1 mV	X10	± 25 μ V *	
1 V	X1	± 2.5 mV	
1 V	X2	± 5 mV	
1 V	X3	± 7.5 mV	
1 V	X4	± 10 mV	
1 V	X5	± 11.5 mV	
1 V	X6	± 15 mV	
1 V	X8	± 20 mV	

* Add correction

9. VOLTS DEVIATION CHECK ($>+10\%$) _____ (✓)
(Paragraph 5-17) ($>-10\%$) _____ (✓)

10. VOLTS OUTPUT MODES AND SQUARE WAVE SHAPE

6125B/C MODE	OUTPUT	SHAPE
-DC	_____ (✓)	_____
OFF	_____ (✓)	_____
10 kHz	_____ (✓)	_____ (✓)
1 kHz	_____ (✓)	_____ (✓)
100 Hz	_____ (✓)	_____ (✓)
10 Hz	_____ (✓)	_____ (✓)

11. 6126C REMOTE PROGRAM CHECK _____ (✓)

12. OPTIONS

IEEE 488-1975 Bus Check _____ (✓)

13. MECHANICAL CONDITION

Test Engineer

Date

with the oscilloscope time base set to 500 ns, 5 μ s, 50 μ s and 500 μ s. Use normal internal triggering (not AUTO) on the 50 μ s and 500 μ s settings. Observe five cycles of 6 division p-p square wave displayed across the graticule of the CRT.

5-19. CALIBRATION AND ALIGNMENT PROCEDURES.

5-20. GENERAL. The following alignment and calibration procedures are used to adjust and align the instrument to its performance specifications. If the instrument cannot be adjusted properly, refer to the troubleshooting and fault-finding procedures in paragraph 5-48.

5-21. REMOVAL AND REPLACEMENT OF COVERS. The top and bottom covers of the instrument are each retained by two machine screws located at the rear panel edge of the covers. Remove these screws and lift up at the rear of the cover. Slide the cover forward and remove the cover from the instrument. Reverse this procedure for replacing the covers.

5-22. POWER SUPPLY CHECK.

a. Connect the ac power line input to the generator through a Variac, or similar line voltage control unit, and use a true rms voltmeter, such as the Ballantine Model 3620A, to measure the input line voltage of the 6125B/C.

b. Connect a digital multimeter, such as the Ballantine Model 3028B to A27TP1 (TIME) (+5 volt supply) and any convenient base or circuit ground. Set the DMM to the 20-volt dc range.

c. Vary the ac input voltage from low line to high line and note that the +5 volt bus reads in the range of +4.7 to +5.3 volts with less than ± 0.1 volt change due to line voltage variation.

d. Repeat for the VOLTS +5V bus at A27TP2.

e. Connect the DMM to A27TP3 (-12 volt supply) and repeat the preceding step d. Check that the -12 volt bus reads in the range of -11.3 to -12.7 volts with less

than ± 0.2 volt change due to line voltage variation.

f. Readjust the Variac to midline and disconnect the DMM.

5-23. DIGITAL METER CALIBRATION. (A23, A24 and A17)

a. Locate 200 ohm resistor A17R1 on the digital meter interconnect board A17. A17R1 is available across A17TP1 and A17TP2. Connect a set of test leads across the input of the digital meter. Be sure the entire instrument has fully warmed up for at least 20 minutes before proceeding.

5-24. METER ZERO ADJUST (A23R10).

a. Tie the test leads connected across A17R1 together. Observe that the digital meter display (A24) reads 0.00 ± 5 digits.

b. Adjust the ZERO Adj. potentiometer A23R10 until the digital display reads 0.00 and does not flash more than one digit once every ten seconds.

5-25. METER FULL SCALE ADJUST (A23R7).

a. Unshort the test leads tied across A17R1 and connect them to the V- Ω and COMMON terminals of a Ballantine 3028B Digital Multimeter.

b. Set the DMM controls to the 200 mV dc range.

c. Set the 6125B/C DEVIATION selector switch to VOLTS $\pm 10\%$. Observe that the VOLTS DEVIATION indicator lamp is illuminated. Then rotate the VOLTS/DIV DEVIATION control until the 3028B DMM reads +100 mV (± 2 mV).

d. Adjust the Span Adj. potentiometer A23R7 until the digital meter reads +10.00 ± 5 digits.

e. Disconnect the leads tied across 200 Ω resistor A17R1 and check zero reading when DEVIATION switch is set to OFF. If necessary, touch up ZERO Adj. A23R10.

5-26. TIME TEST SET CALIBRATION.

a. PRELIMINARY CONTROL SETTINGS. Prior to calibrating or adjusting the instrument set the controls initially as follows:

TIME/DIV.	0.1 μ s
MULTIPLIER	X1
TRIGGER PERIOD	100 μ s
FAST RISE & TRIG AMPLITUDE	Max. cw
DEVIATION	OFF
Marker Trigger Interlock (located internally on A16)	Lockout

5-27. CLOCK FREQUENCY ADJUST (A11C5)

NOTE

Before making any adjustment of the clock frequency or multiplier tuning, allow at least 2 hours warmup at reference conditions. Make all adjustments in the sequence listed.

1. Interconnect the generator and the required test equipment as shown in Figure 5-2. Use a frequency counter with a certified high-stability clock, such as the Ballantine Model 5700A with option 14, connected to the MARKER OUTPUT connector. Be sure that the clock frequency in the counter is fully stabilized and accurate. Use a frequency standard, if available, for the counter clock.

2. The frequency counter must read in the range of 10,000,081 to 9,999,919 Hz when measuring the 0.1 μ s MARKER OUTPUT. If the frequency is near or over the limit, adjust A11C5 until the counter reads in the range of 10,000,010 to 9,999,990 Hz. If A11C5 does not have sufficient range or is near its minimum setting, select a value of A11C6. Typical values for A11C6 are 12, 20, 27, and 36 pF) to bring

the adjustment of A11C5 within range, or replace the quartz crystal and oven assembly if the frequency adjustment cannot be centered on 10 MHz. If the clock of the generator is not set properly to 10 MHz, the accuracy on all generator outputs will be adversely affected.

5-28. PHASE LOCK Adjustment (A12R6).

a. Set the 6125B/C controls as follows:

TIME/DIV	.1 ms
MULTIPLIER	X1
DEVIATION	OFF
TRIGGER PERIOD	1 ms
INT CLOCK OUT/EXT IN	INT OUT
(on rear panel)	

b. Connect an oscilloscope as shown in Figure 5-9. Connect CH1 input to the 10 MHz internal clock output on the rear panel of the 6125B/C. Connect the MARKER OUT to the scope EXT TRIG input BNC.

c. Set the oscilloscope controls as follows:

TRIGGER	+EXT
CH1 VOLTS/CM	.5 V
TIME/CM	.2 μ s
CH2 POS	OFF
CH1 POS	Centered
MULTIPLIER	Pull X10
TRIG. LEVEL	AUTO

d. Adjust the oscilloscope to show a display running through the center of the CRT.

e. Turn the PHASE LOCK Adj. potentiometer (A12R6) until the 10 MHz

TIME and AMPLITUDE CALIBRATOR

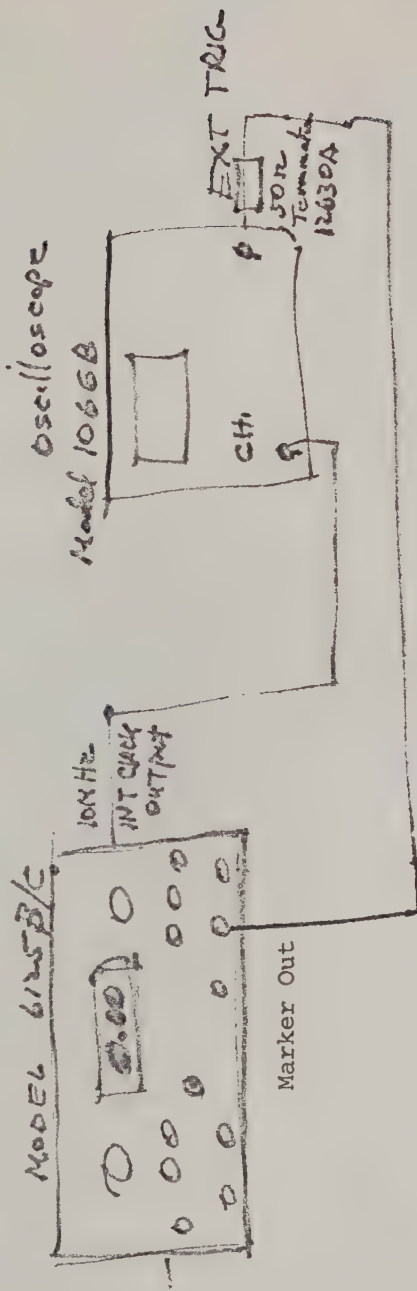


Figure 5-9 PHASE LOCK ADJUSTMENT TEST SET UP

waveform is "locked" to show a stable display on the oscilloscope. Find the limits of adjustment of A12R6 and set to "firmest lock." Switch power OFF and make sure that unit is "locked" when power is restored. Switch to DEVIATION TIME $\pm 10\%$ and back to DEVIATION OFF and check that unit returns to "locked" in DEVIATION OFF mode. Be sure the 6L25B/C is fully warmed up when making the phase lock adjustment and that the 200 and 500 MHz multipliers are reasonably tuned and do not provide outputs more than 600 mV p-p respectively. It may be necessary to repeat the phase lock adjustment after these multipliers are serviced.

5-29. 5 ns (200 MHz) Adjustment (A15C4, A15C6, A15C21)

a. Interconnect the generator and the required test equipment as shown in Figure 5-4. Connect a sampling oscilloscope, such as the Tektronix 547 with S101 plug-in, to the H.F. OUT connector. Set the sampling oscilloscope time base to 5 ns/cm. Connect the TRIGGER OUTPUT to the external trigger input of the sampling oscilloscope. Set TRIGGER OUTPUT to 100 ns. Set the oscilloscope to external positive trigger and adjust the sweep triggering for a stable triggered display.

b. Set the sampling oscilloscope vertical sensitivity to 20 mV/cm. The oscilloscope is then calibrated to 200 mV/cm since the input signal from the generator is reduced by an X10 coaxial attenuator. Observe a 5 ns (200 MHz) sine wave on the oscilloscope.

c. Adjust A15C21 for maximum sine-wave amplitude on the oscilloscope. If no tuning or too little tuning is noted, check A15Q20, A15Q21 and A15Q2, as well as their associated components.

d. It may be necessary to readjust the 200 MHz tune and the 200 MHz trace on the 2 ns (500 MHz) multiplier. Cycle to cycle flatness is to be minimized to avoid amplitude modulation

in the multiplier output. Therefore, touch up A15C4 and A15C6 for best 200 MHz flatness.

NOTE

The preceding adjustments interact. Cycle-to-cycle flatness is an indication of minimal intermodulation distortion which will adversely affect the multiplier and cause poor performance with temperature changes.

e. Sine-wave cycle-to-cycle amplitude modulation should not exceed 5% at 25°C. Use the procedure described in paragraph 5-30. If intermodulation is excessive, replace A15Q20 and A15Q21 with transistors whose beta (current gain) is matched within 25%, and carefully adjust A15T21 no more than one-half turn for optimum amplitude flatness of the 5-ns H.F. OUT sine wave. The cycle-to-cycle amplitude modulation tolerance is for reference only and is not a specification.

f. Again touch up A15C21 for maximum peak-to-peak amplitude which must fall within the range of 0.5 V p-p (2.5 divisions). Do not exceed 0.8 V (4 divisions). Do not exceed 0.8 V p-p or the 10 MHz phase lock system may not function properly. If 0.5 V p-p amplitude is not obtainable, check A15Q20 and A15Q21 and associated components. Check A15T21 and replace if damaged or misshaped.

4-30. Flatness Test Procedure.

a. Adjust the vertical display on the sampling oscilloscope to 5 cm with the variable VOLTS/DIV control on the oscilloscope.

b. Remove the 20 dB (X10) coaxial attenuator from the vertical input of the oscilloscope. Each division on the oscilloscope graticule now represents 2% of the total signal amplitude.

c. Adjust the sampling oscilloscope DC OFFSET control to position the top of the sine-wave display on the screen.

d. Turn the oscilloscope time-position control over a range of at least 25 displayed sine waves. Note the amplitude differences between the various peaks of the sine waves. The maximum to minimum crest difference should not exceed 2.5 of a division or 5%. This tolerance is for reference only and is not a performance specification.

31. 2-ns H.F. OUT ADJUST (A15C4, A15C6, A15C7, A15C9, A15C10, A15C11, A15C14)

a. With all generator and test equipment controls remaining as in the preceding procedure, change the sampling oscilloscope time base to 2 ns per division and the HIGH FREQUENCY switch to 2 ns. Observe a stable 500 MHz (2 ns) sine wave on the oscilloscope.

NOTE

Do not use PC card extender when making 2 ns H.F. OUT adjustments. Do not extend the 50 ohm output cable within the instrument. Use an insulated alignment tool and allow the instrument to be fully warmed up before making adjustments. The phase lock 10 MHz and 5 ns adjustments must be properly aligned before starting the 2 ns calibration.

b. Observe that the 2-ns frequency output provides one sine wave per division on the scope graticule and that the sine wave displayed is at least 0.5 volt (2.5 divisions) peak-to-peak.

c. Adjust A15C4, A15C9 and A15C14 for maximum signal amplitude.

d. Adjust A15C6, A15C7, A15C10 and A15C11 for best flatness and amplitude.

NOTE

The adjustment of A15C4 (100 MHz filter), A15C6 (200 MHz trap), A15C7 (300 MHz trap) and A15C9 (500 MHz Filter A) interact. Repeat steps b and c as necessary for best tuning. Also, do not make any of the capacitor adjustments randomly or too far removed from the original settings. The controls interact and a number of combinations may produce a 500-MHz (2 ns) output; however, only one combination produces maximum amplitude and maximum flatness.

e. If a 0.5-volt amplitude is not achievable, check A15Q3, A15CR1, and the associated components, including all transformers and inductors in the 500 MHz quintupler. Check that the printed circuit board and components are clean and free of flux or other contaminants which may lower the Q of tank circuits and the strip line filter so as to cause a reduction of the 2-ns output signal amplitude.

f. Touch up the output to limit the maximum peak-to-peak 500 MHz signal to fall within the 0.5 V p-p and 0.6 V p-p. Do not exceed 0.6 V p-p or the 10 MHz phase lock may not function properly.

5-32. % TIME DEVIATION BALANCE ADJ. (A12R2).

a. Allow instrument to be thoroughly warmed up with covers on to retain interior temperature.

b. Connect a frequency counter to the TRIG OUT BNC as shown in Figure 5-4.

c. Set the 6125B/C controls as follows:

TRIGGER OUTPUT	1 μ s
TIME/DIV	50 ns
MULTIPLIER	X1
DEVIATION	OFF

d. Observe a reading of 1 000 000 Hz (± 60 Hz).

e. Set DEVIATION to TIME $\pm 10\%$. Note that the TIME DEVIATION indicator lamp is illuminated.

f. Rotate the TIME/DIV DEVIATION control to each end and observe the frequency counter which must vary at least from 900 000 Hz to 1 100 000 Hz.

Adjust A12R2 until the counter maximum and minimum frequency readings are approximately balanced for equal deviation from 1 000 000 Hz at each end of rotation of the TIME/DIV DEVIATION control.

5-33. METER TIME CAL ADJ. (A18R8, A18R6)

a. Use the same test setup detailed in paragraph 5-32. Set the counter to PERIOD mode. Set the 6125B/C TRIG OUT switch to 100 μ s. Adjust A18R8 the +TIME METER CAL adjust potentiometer until the 6125B/C digital meter reads ± 10.00 (± 5 digits).

c. Rotate the TIME/DIVISION control until the frequency counter reads 1.10 μ s. Adjust A18R6 until the 6125B/C digital meter reads ± 10.00 (± 5 digits).

d. A18R6 and A18R8 are somewhat interdependent. Therefore, repeat steps b and c until tracing is achieved.

5-34. REMOTE TIME DEVIATION ZERO ADJ. (A10R4 on assembly 89-10510-1A 6125C only)

a. Continue test setup as detailed in paragraph 5-33. Set DEVIATION to TIME $\pm 10\%$ and set the TRIG OUT switch to 1 μ s. Set the digital counter to frequency mode.

b. Since the digital to analog (D/A) converter on A10 is an 8 bit (256 steps) binary converter, it is necessary to set it half way up to its maximum by energizing setp 128. Do this by connecting pin 6

of A10U4 to +5 volts. Energize the 1 μ s TRIG OUT range and DEVIATION as indicated in Figure 5-5 the TIME Truth Table.

c. Adjust A10R4, the Remote Time Deviation Zero Adjust until the 6125C digital meter reads 0.00 ± 10 digits. The frequency counter should then read 1,000,000 ± 1000 counts which serves to check TIME DEVIATION calibration.

5-35. VOLTS CALIBRATION

5-36. Paragraphs 5-37, 5-38, 5-39, 5-46 and 5-47 provide qualitative performance check prior to calibration. These checks are optional but should be performed periodically or as part of troubleshooting procedures.

5-37. VOLTS OUTPUT SOURCE RESISTANCE AND DIVIDER CHECK.

a. Turn OFF mains power on the 6125B/C. Set OUTPUT MODE to GND, MULTIPLIER to X1 and DEVIATION to OFF.

b. Make all measurements indicated with the ohmmeter of the Ballantine 3028B DMM. Use LO ohms and read as close to full range (1999) as possible.

c. Measure resistance from 6125B/C case to shell of the floating VOLTS OUT BNC connector. This reading must be 80 to 120 ohms.

d. Measure resistance from the center pin to the shell of the floating VOLTS OUT BNC connector. This should be nominally 220 ohms with the VOLTS/DIV switch set to 10 μ s and increasing with each increased range until nominally 2.75K ohm is measured at 10 mV.

5-38. VOLT OUT SHORT CIRCUIT CHECK.

a. Set mains power line voltage to midrange as indicated in paragraph 5-8.

b. Set 6125B/C controls as follows:

VOLTS/DIV	20 V
OUTPUT MODE	+DC
MULTIPLIER	X10
DEVIATION	OFF

c. Use 3028B DMM to measure VOLTS OUT. Connect V- Ω to center pin and COMMON to shell of VOLTS OUT BNC connector. Set 3028B to V DC 1200 V range. Observe a reading of nominally +200 V DC.

d. Set the 3028B DMM to DC, A, 200mA range. Transfer the test lead from the V- Ω binding post to the A binding post. The low ammeter shunt resistance will now short circuit the 6125B/C VOLT OUT BNC. Observe that the short circuit current falls within the limits of 25 to 40 mA. This serves to check the volts circuitry.

CAUTION

Observe the 200 volt signal levels and use care to avoid shock hazard.

Do not short the VOLTS OUT BNC continuously. Only short 2 to 5 seconds when performing the short circuit current measurement.

e. Repeat step c to check that the VOLTS OUTPUT is properly restored after the short circuit test.

39. VOLTS SUPPLY CHECKS.

a. Set the mains power line voltage midrange as indicated in paragraph 5-8.

b. Select GND with the OUTPUT MODE switch. Set VOLTS/DIV to 20, DEVIATION OFF and MULTIPLIER to X1.

g. Use the 3028B DMM to measure the internal unregulated power supply voltages as indicated below:

Test Point	Location	Measurement Unit
A2TP1 to A2TP2	Across A2C2	260V to 320V DC
A2TP3 to A2TP4	A2CR11 cathode to Junction of A2R14 and A2C7	15V to 20V
A2TP5 to A2TP6	A2Q1 collector to Junction of A2R4 and A2C2	15V to 20 V

5-40. VOLTS CIRCUIT REGULATION

a. Connect the 6125B/C to the power line thru a variable autotransformer and monitor the voltage to the power mains input of the 6125B/C.

b. Set the 6125B/C controls as follows:

VOLTS/DIV	20 μ s
MULTIPLIER	X10
OUTPUT MODE	+DC
DEVIATION	OFF

c. Connect a BNC "T" connector to the VOLT OUT BNC.

d. Use a differential voltmeter such as the Fluke 885AB to measure the VOLTS OUT. Connect the HI binding post of the differential voltmeter to the center pin of the BNC "T" and connect the LO binding post of the shell of the BNC "T" connector.

e. Set the power line voltage to midline. Refer to paragraph 5-8 for power line voltage details.

. Balance the differential voltmeter on the ± 100 mV null range.

. Lower the power line voltage to the low line limit. Note that the differential voltmeter null has not been unbalanced by more than ± 80 mV.

. Raise the power line voltage to the high line limit. Note that the differential voltmeter null has not been unbalanced by more than ± 40 mV.

. Reset the power line voltage to midline and rebalance the null of the differential voltmeter.

. Connect a 1 megohm terminating resistor across the open leg of the BNC "T" connector on the VOLTS OUT BNC. Use a 1% resistor or simply connect the 1066B oscilloscope CH1 input to the BNC "T" with a BNC/BNC coaxial cable. Set the oscilloscope input coupling switch to dc and the scope attenuator will act as a 1 megohm termination.

. Observe the change in output voltage when terminating with 1 megohm. This is read on the differential voltmeter and should not exceed ± 100 mV.

41. 200 VOLT CALIBRATION ADJUST (A3R9).

. Maintain the test equipment set up as in paragraph 5-40. Be sure the 1 Megohm terminating resistor is tied to the VOLTS OUT BNC T and that the power line voltage is set to midline.

. Set the dials of the differential voltmeter to +200.00 volts and the null range to ± 100 mV. Allow 5 minutes for temperature stabilization.

. Adjust A3R9, the 200 volt CALIBRATION potentiometer, until the differential voltmeter shows a null within ± 25 mV.

. Change OUTPUT MODE to -DC and differential voltmeter to -200.00 volts. Observe that the differential voltmeter indicates null within ± 100 mV.

e. If A3R9 cannot be brought into range, add or delete one or both links located across A3R10 and A3R11.

5-42. VOLTS METER CAL Adj. (A18R2)

a. Refer to paragraph 5-41a for test equipment setup.

b. Set DEVIATION switch to VOLTS $\pm 10\%$. Note that the DEVIATION indicator lamp is illuminated.

c. Set the dials of the differential voltmeter to +220.00 volts and reduce its null sensitivity to ± 100 mV.

d. Rotate the VOLTS/DIV DEVIATION control until the differential voltmeter shows a null for its 220 volt setting.

e. Set the VOLTS METER CAL Adj. A1R2 until the 6125B/C digital meter reads $+10.00\%$, ± 5 digits.

f. Reset the dials of the differential voltmeter to +180.00 volts.

g. Touch up the A18R2 until the digital panel meter reads -10.00% , ± 5 digits.

h. Repeat steps c through g until the best compromised setting of A18R2 results in a digital meter setting of $\pm 10.00\%$, ± 8 digits.

i. Reset DEVIATION to OFF and check that digital meter reads 0.00% , ± 2 digits.

5-43. 60 dB ATTENUATOR CAL Adj. A7R20.

a. Refer to paragraph 5-42a for test equipment setup.

b. Perform the following check with test equipment adjusted as indicated in Figure 5-2.

	6125B/C			
OUTPUT MODE	VOLT/DIV	MULTIPLIER	Differential Voltmeter Dials	Null Limits
+DC	20 V	X10	+200.00	+30 mV
+DC	10 V	X10	+100.00	+250 mV
+DC	5 V	X10	+50.000	+125 mV
+DC	2 V	X10	+20.000	+50 mV
+DC	1 V	X10	+10.000	+25 mV
+DC	0.5 V	X10	+5.0000	+12.5 mV
+DC	0.2 V	X10	+2.0000	+5 mV
+DC	0.1 V	X10	+1.0000	+2.5 mV
+DC	50 mV	X10	+0.5000	+1 mV

43. Set VOLTS/DIV switch to 20 mV and the MULTIPLIER to X10.

44. Set differential voltmeter dials to 20000 and the null range to $\pm 100 \mu\text{V}$. Allow 5 minutes for temperature stabilization.

45. Adjust A7R20 the 60 dB ATTENUATOR L Adj. until the differential voltmeter reads null $\pm 20 \mu\text{V}$.

44. SQUARE WAVE ZERO LEVEL Adj. A3R2

This adjustment is only of consequence when using the VOLTS OUT in square wave mode for amplitudes less than 100 μV when it serves to set the square wave reference level to ground. Normally, it is sufficient to center this control and the following adjustment procedure is optional.

46. Set the 6125B/C controls as follows:

VOLTS/DIV	20V
MULTIPLIER	X10
DEVIATION	OFF
OUTPUT MODE	+DC

47. Provide a low voltage dc supply which may be floated ± 400 volts with respect to the case ground of the 6125B/C.

48. Adjust the output of this supply to provide 1 volt ± 0.020 volts.

49. Turn OFF the floating low voltage dc supply and connect its positive output to the junction of resistors A3R6 and A3R1. Connect the negative output of the floating dc power supply to the emitter of A3Q4.

50. Connect the differential voltmeter to the VOLTS OUT BNC connector. Set the differential voltmeter dials to +200.00 and its null range to $\pm 100 \text{ mV}$.

51. Note that the output voltage is $\pm 20 \text{ mV}$.

52. Turn ON the low voltage dc power supply and set the differential voltmeter dials to 0.0000.

53. Observe that the VOLTS OUT is approximately zero volts.

54. Adjust A3R2 until the VOLTS OUT voltage read on the differential voltmeter is zero volts $\pm 5 \text{ mV}$.

55. As an additional check, temporarily touch a 2.2 megohm resistor from collector to emitter of A3Q3 and verify that the output voltage does not increase by more than +50 mV.

56. Turn the 6125B/C POWER OFF and disconnect the low voltage dc supply.

-45. 60 dB ATTENUATOR FREQ. Adj. A7C11

a. Connect an oscilloscope to the VOLTS OUT NC connector through a BNC/BNC coaxial cable having nominally 120 pF of capacity. The allantime 12249D cable is recommended.

b. Set the 6125B/C controls as follows:

VOLTS/DIV	50 mV
MULTIPLIER	X10
OUTPUT MODE	10 kHz
DEVIATION	OFF

c. Set the oscilloscope controls as follows:

CH1 only

VOLTS/DIV	0.1 V
Coupling	DC

Triggering

Source	Internal
Slope	+
Mode	Auto
Coupling	AC

Time Base

TIME/DIV	50 μ s
Magnifier	X1

The oscilloscope monitors the VOLT OUT square wave and should be adjusted to stably display 5 cycles of the 10 kHz square wave across the CRT. The square wave amplitude is nominally 5 divisions (500 mV) peak to peak.

Adjust the oscilloscope TIME/DIV to 50 μ s/DIV and display the leading edge of the square wave.

Measure the 10 to 90% rise time of the square wave and verify that it is equal to or faster than 6 microseconds.

f. Reduce the VOLTS/DIV switch setting to 20 mV.

g. Set the oscilloscope VOLTS/DIV switch to 50 mV/DIV and set the oscilloscope TIME/DIV switch to 20 μ s. Adjust the oscilloscope to display 2 cycles of square wave on the CRT with an amplitude of 4 divisions (200 mV).

h. Adjust A7C11 the 60 dB ATTENUATOR FREQUENCY Adj. for best square wave flatness with minimum rounding or overshoot.

i. Check a number of other VOLTS/DIV settings to be certain that there are no waveform abnormalities on other ranges.

5-46. VOLTS OUT RIPPLE CHECK (Optional)

a. This test is optional. It is provided to permit a low voltage power line check of the VOLTS circuitry.

b. Connect the 6125B/C power input through a variable line control unit. Monitor the power line voltage with a true rms voltmeter and set the voltage to low line as referenced in paragraph 5-8.

c. Set the 6125B/C controls as follows:

OUTPUT MODE	+DC
VOLTS/DIV	20 V
MULTIPLIER	X10
DEVIATION	OFF

d. Connect an oscilloscope to the VOLTS OUT BNC connector. Set the oscilloscope controls as follows:

CH1 Input	
VOLTS/DIV	0.1 V/DIV
Coupling	AC
Triggering	
Source	Internal CH1
Coupling	AC
Mode	Auto
Slope	+
Time Base	
Time/Div	10 ms
Magnifier	X1

e. Verify that the peak to peak ripple displayed on the CRT is less than 2 divisions (0.2 volts) peak to peak.

f. Reset power line voltage to midline.

5-47. LINE FREQ. AMPLITUDE

a. Connect an oscilloscope to the LINE FREQ. OUTPUT BNC connector of the 6125B/C.

b. Set the oscilloscope sensitivity to 0.5 Volts/Div.

c. Rotate the LINE FREQ. AMPLITUDE control and verify that at least 1 volt peak to peak sine wave output amplitude may be obtained. Check the sine wave displayed on the CRT and note that it is clean, free of noise and has negligible harmonic distortion.

5-48. TROUBLESHOOTING.

5-49. The troubleshooting procedures should be performed only when the instrument cannot be calibrated using the procedures of paragraphs through . Should the instrument be inoperative or completely out of specifications, proceed with the following fault-finding procedures:

a. Carefully examine the instrument and check for any visual evidence of trouble. Check for broken wires, burned resistors, loose components, and shorted, open, or defective solder joints on the printed circuit board. Check for separation of printed circuit board lands and pads. Check for open, defective, or intermittent switches. Check that connectors are clean and mate properly. Check that the instrument circuit ground is shorted to the chassis ground.

b. Understand and be familiar with the circuit theory of Section 3. Use the functional block diagram, Figure 3-1, and the schematic diagrams in Section 6 to isolate the probable circuit areas which may cause the problem. Always check the power supply voltages and check for oscillations in the circuitry.

5-50. PRINTED WIRING BOARD REPAIR AND CLEANING.

5-51. The generator uses an etched-copper printed circuit board. The main printed circuit board uses plated-through holes. To prevent damage to the circuit board and components, observe the following instructions when soldering:

a. Use a low-heat-capacity soldering iron with a 700°F tip, 1.5 mm (1/16 inch) to 2.5 mm (3/32 inch) wide, similar to Weller Model No. W-TCP, 60 watts.

b. Be sure that the soldering iron tip is grounded to the power line "earth" ground to avoid possible overvoltage damage to semiconductor and tantalum capacitors. Also, "earth" ground the case of the instrument.

c. When removing a component, clip a heat sink, such as long-nose tweezers, or alligator clips, to the component leads, as close as possible to the body of the component, to ensure minimum heating of the component when soldering.

d. Place the soldering iron directly on the component lead on the conductor side of the printed circuit board. Use a desoldering tool such as the SOLDAPULLT, manufactured by Edsyn Products, to remove all solder and free the component lead.

e. Straighten the component lead with long-nose pliers and remove the component from the board.

f. If a component is obviously faulty or damaged, clip the leads close to the body of the component and remove the leads remaining from the conductor side of the board.

g. Use a short soldering cycle since excessive or prolonged heat may destroy the laminate board and lift the copper conductors from the circuit board, or cause immediate degradation or latent damage of the components.

h. Clean the component lead holes by heating the solder on the circuit board conductor pad, quickly removing the soldering iron, and inserting a pointed nonmetallic object, such as a toothpick, to clean the hole. Do not allow solder to cover the hole since new component leads may then push the pad away from the board.

i. To install a new component, straighten and shape the leads. Insert the component into the proper holes. Bend the leads at the conductor side of the circuit board so that they fall over the pad and extend over the foil of the incoming conductor path. Cut the bent lead approximately 2.5 mm (3/32 inch) from the hole. Clip a heat

sink to the component lead at the body of the component. Heat the lead and the pad with a soldering iron and use fresh solder (60/40) as required to cover the lead and form a meniscus over the hole to ensure a good electrical connection.

j. After either removing or inserting a component, clean excess flux from the connection and surrounding area. Use TF Freon spray cleaner, such as Miller Stevenson Chemical Co., Type MS-180 (Ballantine P/N 80-10004-0A), low air pressure (5 to 20 PSIG), and a humidity seal spray, such as Humiseal, Columbia Technical Corp., Type 1B15 (Ballantine P/N 80-10005-0A), to seal the board and protect it against humidity. To avoid unwanted leakage, which may affect performance if the instrument is exposed to high humidity, do not touch the cleaned board or handle the components excessively.

CAUTION

Be extremely careful when cleaning the multiplier coils and adjacent components. Never bend the coils. Distorted coils and transformers may drastically affect the functions, calibration, and performance of the instrument.

k. Do not permit water or solvents to get into switches, connectors, or sockets. Avoid using corrosive cleaners which may damage metal or plastic parts.

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